How to Use Concrete

Mrs. R. W. Lesley 4/11/36

How to Use Concrete

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A Book
of
PRACTICAL
INFORMATION
NOT FOUND ELSEWHERE
About the Uses of
CONCRETE

Written in Plain
English for the
Practical
Man

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BEFORE YOU READ THIS BOOK

Let us tell you its object. The editors have striven to set forth in these pages, in plain everyday English, the fundamental principles governing the uses of concrete. We believe that all of the methods described here are practical. The molds illustrated can be made by any one at small expense. Read the instructions carefully before attempting to follow them.

Many of the points made will seem elementary to the concrete man. We have made them so because we want to teach the novice how to use concrete. We want to impress upon the beginner the many advantages of concrete. We urge upon everyone—beginners and experienced workers—the importance of doing good, honest work. Don't try to make a 1:6 mixture do the work of a 1:4 mixture. Concrete is a wonderful material, but don't try to do impossible things with it. Know what you're doing. If in doubt, write to the publishers of this book for information—it will cost you nothing.

We have tried to make this book complete, but we realize that no book was ever made exactly right the first time. If you see errors in these pages, call our attention to them. If you have ideas of your own that would help others, tell us about them in order that we may add new features to future editions.

A large portion of this book is given up to descriptions of easily-made molds and instructions for their use in the manufacture of concrete products. In most instances there are no regularly manufactured machines for making the products described, in which case the concrete man must use a home-made device. It is certain, however, that as the concrete industry grows, the manufacturers of concrete machinery will place upon the market molds and appliances for making all of these products.

Our advice to the concrete products manufacturer is, in making goods for the trade, in any large amount, use a standard metal machine. While the molds described in this book will turn out creditable work and any man can make them with little trouble and a small investment, in establishing a permanent line of products it is well to buy a permanent equipment.

In publishing this book, the editors take this occasion to express their obligation to those sources of information that have made the Information Department of CONCRETE possible. Acknowledgment is hereby made to the contributors to CONCRETE, to A. A. Houghton, Paul Wilkes, Warren A. Miller, C. A. Wittbold, Frank M. Kennedy, H. M. Bainer, H. B. Bonebright and Walter B. Snow; to The Atlas Portland Cement Co., Universal Portland Cement Co., Marquette Cement Mfg. Co., Vulcanite Portland Cement Co., Lawrence Portland Cement Co., Edison Portland Cement Co., Sandusky Portland Cement Co., Ideal Concrete Machinery

Co., Trussed Concrete Steel Co., Michigan Technical Laboratory, Century Cement Machine Co., Cement Tile Machinery Co. and Miracle Pressed Stone Co.; to the publishers of *Engineering-Contracting, The Iron Age, The Practical Engineer, The Municipal Journal and Engineer;* to the Association of American Portland Cement Manufacturers and the National Association of Cement Users. Especial thanks are also due the advertisers in this first edition, whose support has helped to publish the book in its present form.

THE EDITORS.

METHOD OF MOLDING MONOLITHIC CONCRETE BALUSTRADES.

In view of the fact that ornamental concrete is now a subject of interest to every concrete worker, the two novel forms of balustrades shown in the illustrations should be of value to those seeking something out of the ordinary.

The method of building the forms is very simple. One design, as shown in Fig. 1, requires simply a box form open on one entire side for placing the concrete, reinforcement and center partitions for molding the desired shape.

To build the form for a height of 24″ use two boards 7″ wide, and as long as you desire the panel, for the top and the bottom; these lap over the side boards and thus leave a width to molded rail of but 6″.

Two 4″ boards are used for one side of the rail and two 2½″ and two 1½″ strips to mold the inside edge of the rail, as shown in the illustration. For the panel center, use two 8″ boards joined together; to this are nailed the two 2½″ strips on one side and to these strips are nailed the two 4″ boards. The two 7″ top and bottom boards are hinged to this form so as to fold back and allow the mold to be emptied easily. The two ends are also made of 7″ lumber, 26″ long, hinged to one side of the mold so that the whole form folds away from the completed work.

Two blocks are nailed to each end as shown in the illustration. These are fastened 6″ in from each end and the two 1½″ strips are set up against these blocks to mold the projecting side of the rail, on the open side of the mold. To hold in place, use a small hook at each end, fastened to the blocks.

This allows the upper and lower rails to be molded 6″ wide and 4″ thick, with a panel center of 3″ thick and 16″ high.

For the forms to mold openings in panel center, build forms 3″ high and 7″ square in the form of a box without top or bottom—build one of these for each 13″ of balustrade it is desired to mold—linear measure. Also build half forms of this same size, as illustrated, building four extra. Place these forms at even distances apart, resting on the boards of the panel center and lightly tack them to the latter, so that they will remain in place.

The mold rests flat on one side of work table and the concrete and reinforcement are placed while in that position, thus enabling the operator to tamp each portion thoroughly. As soon as the form is filled to the height of the panel the removable 1½″ strips are set in place and the top and the bottom rail finished. In removing the work from the form these strips are taken out, the four sides folded back and the form turned over, thus removing the completed work—the work, of course, having remained in the mold until the concrete is hard enough to stand handling.

Where bevels are desired on the four sides or corners of each rail, bevel strips may be nailed to the corners of the mold or any molding may be used for this purpose. Do not nail the latter to the top and bottom boards on the closed side of the mold, as this would prevent them from folding back from the work.

To make a more massive panel do not have the openings extend within four or six inches of each end, as this can set up against or into the pilaster or column. When desired, the base of the column to receive this balustrade may be molded around the latter by blocking up the balustrade in the proper position and then cutting out one side of the column mold so that the balustrade will set into it. They are thus bonded together when the column or pilaster is molded. This makes a more satisfactory job, as the work is much stronger and the pilaster can be molded more easily in the position in which it is to be used than can the curtain wall or panel.

Any desired reinforcement may be used, but good results are accomplished with twisted strands of heavy wire laid diagonally in the concrete after an inch of mortar is laid in the forms—these wires should extend up to and join the long wires used in the top and bottom rails.

The form as described is massive enough to be used in all ordinary work without reinforcement, when properly molded, but if so desired the dimensions may be cut down one-third and the reinforcement added with safety, where a lighter panel is desired to match the columns of the veranda.

ANOTHER SIMPLE DESIGN.

While the second form (Fig. 2) appears to be very complicated it is really more easily built. The main form is the same as that shown in Fig. 1, with the exception that four rails are used and that it cannot well be built under 34″ in height.

The top rail is 2″ deep and 6″ wide on top. The openings between this and the second rail are 4″ deep and 10″ long, with the second rail the same size as the top rail. The center panel is 16″ high, but may be reduced to 12″; the third rail is the same as the first two, and the bottom rail is 4″ deep.

The panels in the center and the two between the rails should not be over 3″ in thickness and may with better effect be 2″.

As illustrated, the circular openings are made from round boards built up of several thicknesses to make the right height and for a 16″ panel should be 10″ in diameter; they are lightly nailed to the bottom part of the mold as the squares were in Fig. 1.

The small blocks for the openings at each quarter of these circles are made from the cuttings in building the circles and are cut to mold a 2″ space between them and the circle, as well as a 2″ upright on one side, as illustrated.

In molding the panel between the top and the bottom rail, use 4″ boards, cut 10″ long, cutting each end in a half circular form; build these up to the required thickness and tack in position as shown in the illustration.

The inside edge of the top and the bottom rail and both edges of the two center rails where they project beyond the panels are molded on the face side of mold with 1½″ strips set in place as the work is molded, and

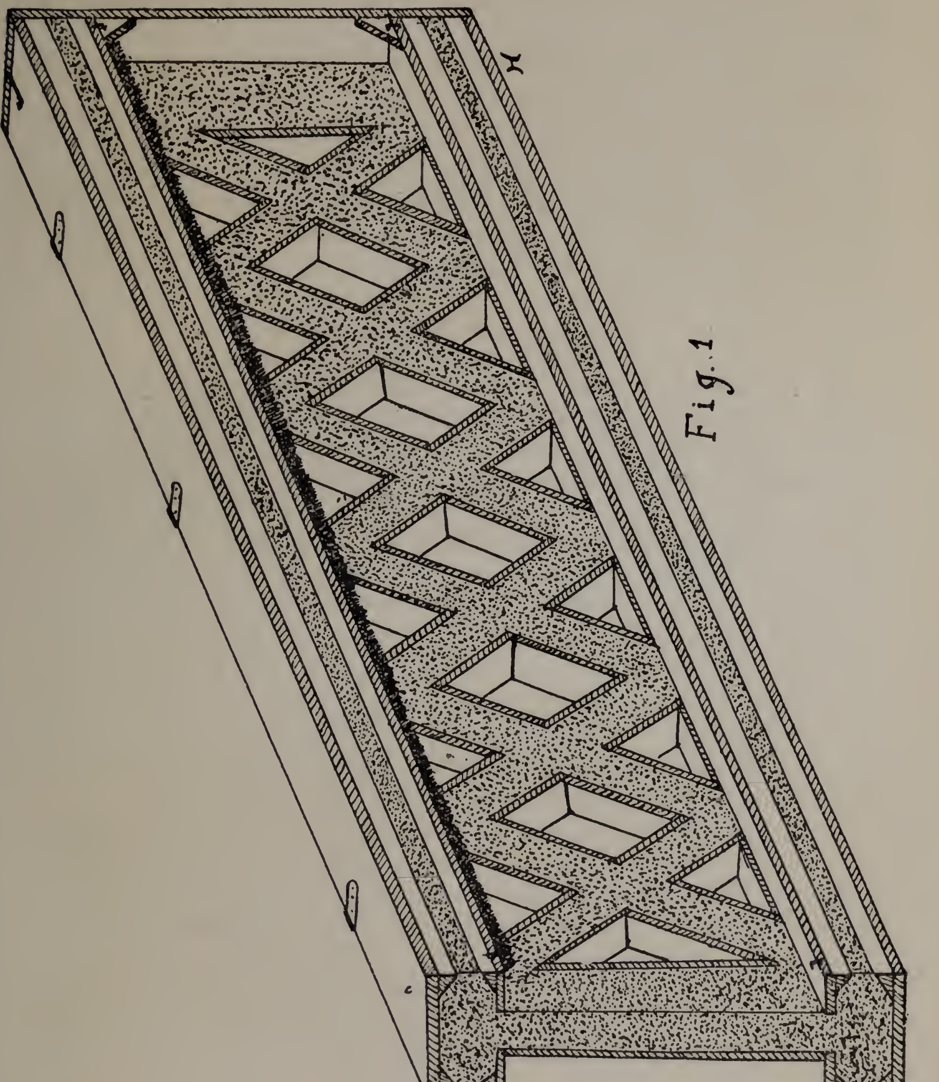


Fig. 1

fastened to the ends of mold in the same manner employed with these strips in Fig. 1.

Molding the projecting edges of the rails on the bottom side of the mold is accomplished as shown in Fig. 1—by building the form for them into the bottom of the mold.

This makes a very pretty balustrade and one that can be easily molded at small expense, yet would command a good price for the builder.

In this work good results can be accomplished only by molding the work and allowing it to cure thoroughly before placing in position, as it would be very difficult to design a mold that would turn out the work in any other manner. The two designs shown may also be employed as lattices if desired.

USE OF WOOD FIBER MOLDS.

If it is desired to copy from a wood model as, for instance, a cap, baluster or newel post, the mold for it can be made by building a box form several inches larger than the pattern. Place in this the common wood fiber, such as is used for plastering, from which you have sifted the woody fibers. After laying a coat of this in the bottom of the mold, place in your pattern, previously well greased, and then cover with the wood fiber mortar; allow this to harden and it may be cut in the center with a saw, the same as a wooden board; this, of course, divides the pattern, but produces a quickly made and satisfactory mold for small work. It is simply held together with hooks and eyelets. The concrete is poured into it through a hole which may be cut in the top or bottom of the mold. By coating these molds with shellac or even greasing thoroughly each time before using, they may be made to produce a large number of perfect casts and where continued use is not demanded they will give very satisfactory results.

A very useful hint for building rails where separate balusters or spindles are to be used—one that will make a neat job with less work—is to mold a groove in the under side of the top rail and a similar groove on top of the bottom rail, both grooves of the exact width of the spindles or balusters. These slots should be ½″ to ¾″ deep. The spindles are slipped into them from one end of the panel. When the spindles are properly placed, the grooves between them are filled with thin mortar to fill out the rails. This locks the spindles in place and makes it very easy to put the work together.

The best results are always secured with a wet mixture of concrete for work of this nature, where every portion of the mold must be fully filled to produce an even face on the work. As this also allows a smoother finish to be given to the surface that is troweled, its use is an advantage when wood molds are to be employed.

The concrete worker who employs the main parts of the molds described in this article may produce a large number of different designs of lattices and balustrades, and work of this kind is simple and profitable.

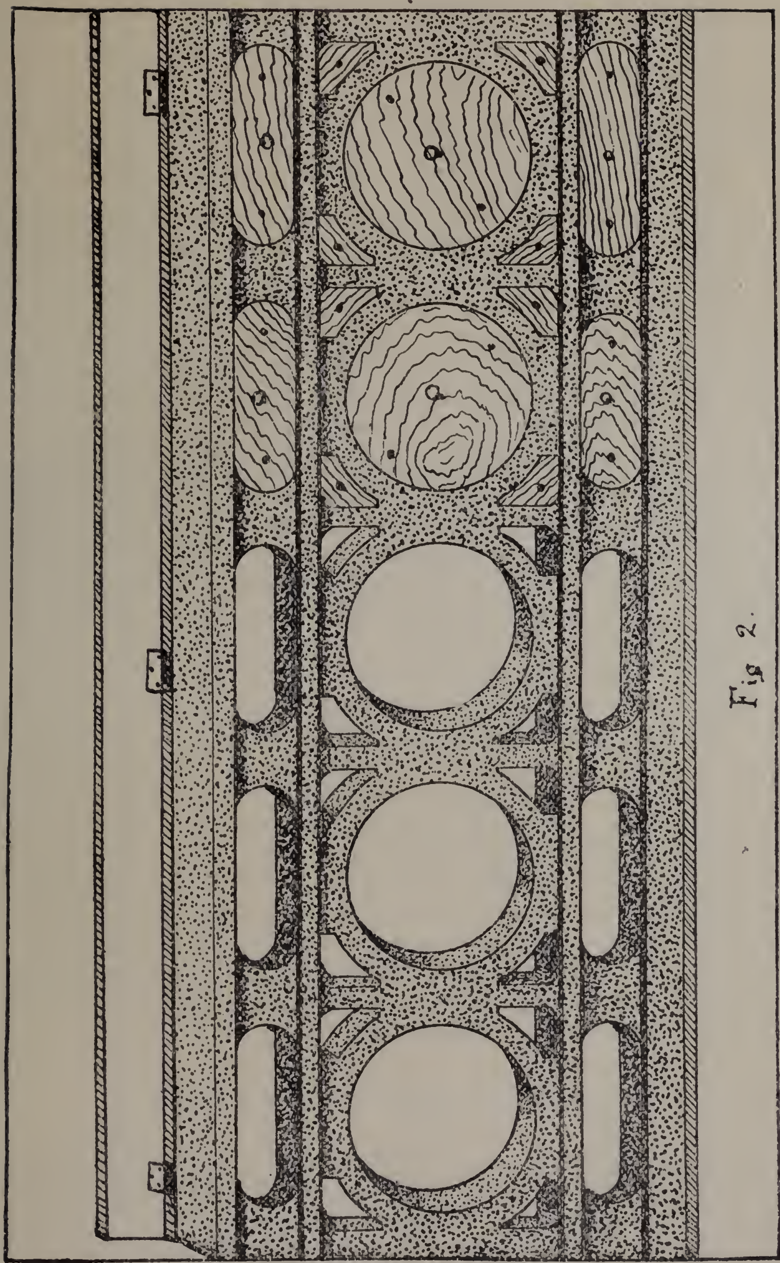


Fig 2.

HOW TO MAKE A SEAWORTHY BOAT OF CONCRETE AT SMALL COST.

Up to the present time concrete workers have been bending their energies toward perfecting themselves in the more practical uses of the material in hand and but little has been done toward employing concrete in less serious pursuits. Many boys, and not a few men, who have access to a lake or pond, would like to possess a boat, and while boat-building is a difficult art when the usual methods are employed, the use of concrete as a material simplifies the problem to such an extent that a very trustworthy craft can be built at little expense and will last several generations.

Only a few dollars are necessary for the purchase of Portland cement, steel rods and wire, and nature furnishes sand and clay, the only other things needed, in almost all localities. The writer will in this article describe in detail a method of building a concrete boat without requiring a carpenter to build the forms and without any outlay for lumber for forms. By following these directions any boy can build a boat for his own use, and the same methods can be used for building boats for commercial purposes, or for constructing bridge pontoons.

After having decided upon the wood boat that is to be duplicated, secure this boat and make it serve as the inside form for the concrete structure. Hang the wood, or steel, boat near the shore of the lake where the new boat is to be launched, following the method illustrated in Fig. 2. The outside form consists of clay, worked to the consistency of painter's putty and pressed into shape as shown in the illustration. Build up a wall of clay around the suspended boat from 6″ to 10″ thick, keeping the inside surface perfectly smooth and leaving an even space between it and the wood boat, the thickness of this space corresponding to the thickness of the wall of the concrete boat as planned. A small piece of board the thickness of the concrete wall will be of use in securing a smooth surface on the clay wall and a uniformly thick concrete wall.

ANOTHER METHOD SOMETIMES USED.

In building boats of such a size that they can be lifted by one or two men, the clay may be pressed tightly against the original boat itself. The boat may then be lifted and the clay walls compressed by it in such a way as to form a space the thickness of the concrete wall required for the surface of concrete. In every case the boat should be forced against the clay with short strokes, like those of a hammer. Care should be taken not to crack the clay wall and to secure an even space all around the boat when it hangs free in the mold.

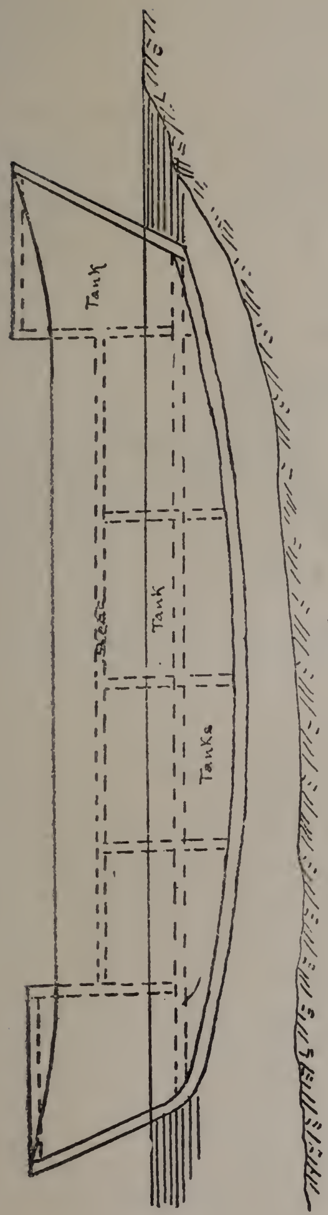


Fig. 1.

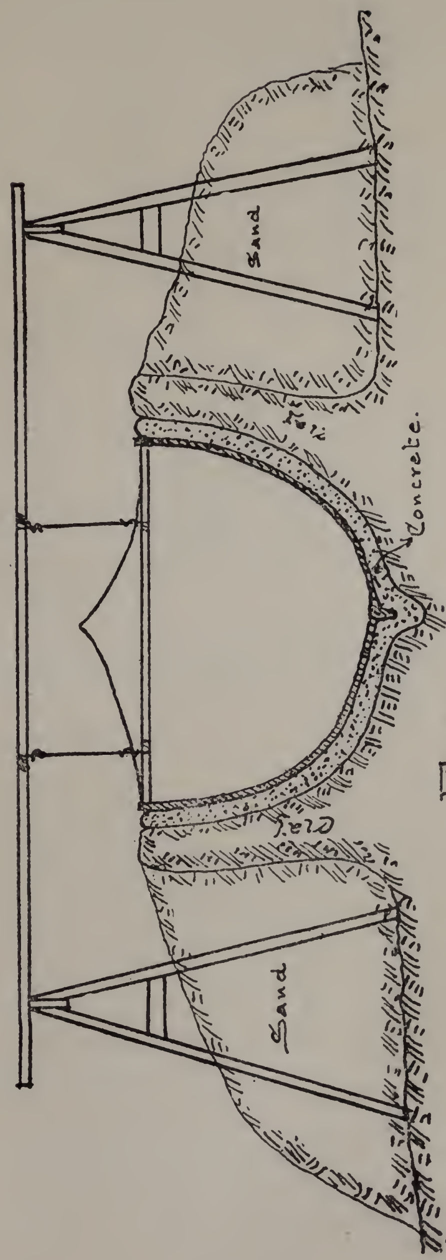


Fig. 2.

Now lift the boat out and cut the clay away at the keel and other places so as to secure a uniform thickness of the concrete wall when it is poured.

In order to protect the clay mold from settling or other damage, shovel sand all around it as indicated in Fig. 2. Take the boat out and repair all imperfections in the clay negative and brush the whole surface smooth and even with a painter's brush and water. The model boat may now be hung in its original position, and the form is ready to receive the concrete.

In order to protect the paint on the original boat and to facilitate its removal from the concrete after the latter has set, stick straw paper, or two or three thicknesses of newspaper, over the outside, using only enough paste to hold the paper to the boat's surface. Then paint over the paper a coat of grease, composed of talc dissolved in hot petroleum. By using these

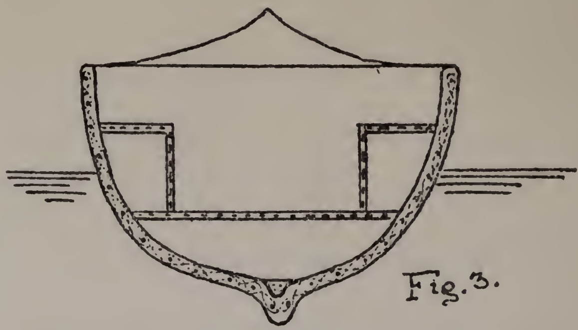


Fig. 3.

precautions, no difficulty will be encountered in removing the original boat, after the casting.

REINFORCEMENT.

The even spacing of steel rods and wire, in both directions, has an important bearing upon the strength of the finished boat. The stresses produced by water pressure upon the walls when the boat is afloat are small, in a small craft, compared to the stresses produced by handling the boat on land. For this reason it is advisable to place the reinforcement nearer the outer surface of the boat's wall. In most cases if the steel is distributed in an area at a distance from the outside surface equal to one-third the thickness of the wall, the best results will be obtained.

In order to assure the even spacing of the reinforcement, a web of steel rods and wire may be woven on the outside of the paper covered boat, the wire impinging on the sides at different points, keeping the heavy reinforcement at a uniform distance away. The crossing points of rods and wires may be bound, to give greater stability to the metal skeleton that swings in the space between the clay mold and the model boat. Fig. 4 illustrates one method of weaving the web. Expanded metal might also be utilized, and perhaps with less trouble.

With the mold and the reinforcement ready for the pouring, it is imperative that there should be no delays in placing the concrete. To secure the best results the work should be completed in one day, so as not to allow one pouring of concrete to set partially before the balance is deposited.

In mixing the concrete use Portland cement and clean, sharp, well-graded sand in the proportion of one to three. Mix the cement and sand thoroughly before adding the water, and use enough water to make a thin cream or grout. Pour this into the mold to an even height all around and smooth off the tops of the walls.

REMOVING THE FORMS.

Allow the mold to remain undisturbed for about six days, after which time the wood boat may be lifted out easily and cleaned. Remove all paper adhesions from the inside of the concrete boat and paint over the surface with a mixture of cement and sour milk, mixed to the consistency of paint. This will give the inside of the boat a smooth finish and make it absolutely waterproof. The addition of a waterproofing compound to the concrete mixture of which the boat is made will make assurance doubly sure in the matter of waterproofness.

In case it is desired to build air-tight tanks in the boat to prevent overturning, these can be made without trouble. Build a false floor of boards in the bottom of the boat and seal with a layer of concrete, reinforced with wire mesh a little stronger than fly-screen. Partitions in the air chamber below this floor can easily be built. In like manner, tanks may be constructed at the sides to serve as seats, and at the stern and bow, as shown in Figs. 1 and 3.

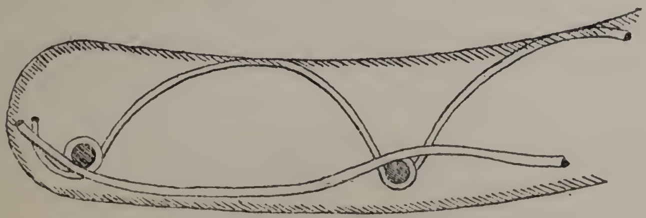


Fig. 4

In order to be sure that these tanks will do the service for which they are designed in case of accident, figure the amount of concrete in the boat, with the proposed partitions, in cubic feet, and multiply it by the weight of a cubic foot of concrete; add to this the weight of the reinforcement, the machinery and the passengers. This will give the complete weight of boat and contents. Figure the clear air-space in the tanks and multiply by the weight of a cubic foot of water. This weight should be greater than the gross weight of the boat and contents in order to insure the craft against sinking, in case of accident.

Before attempting to build a concrete boat by this method, it is advisable to draw the plans and indicate carefully the size and position of all the machinery parts, partitions and tanks, and provide for the placing of all metal fastenings, chains, hooks, etc., as most of these can be attached to the inside mold and embedded in the concrete when it is poured.

After the boat has stood in the clay mold for two or three weeks, it may be removed, turned over and finished on the outside. All clay deposits should be washed off, and all unevenness in the concrete should be removed. The finishing touch is the application of a paint of Portland cement and sour milk, to which has been added mineral color to suit the owner.

THICKNESS OF THE WALLS.

In case a boat of considerable weight is built, it is best to build it near the shore and launch it by digging a canal around it when completed. Ordinarily a concrete boat with walls from 1½″ to 2½″ in thickness will be suitable for use with a motor or gasoline engine. For a boat of this character the reinforcing should consist of ¼″ rods, spaced to form 6″ squares. Tank walls and partitions should be from 1½″ to 2″ thick, and braced every three or four feet.

Amateurs who have had little experience in concrete construction should consult with a civil engineer or a concrete contractor before attempting to build a concrete boat, as the manner of mixing and placing the concrete is second only in importance to the correctness of the design. Before putting the craft into actual use it is wise to test its capacity by loading it with sand and stones.

In the writer's opinion, many boats will be constructed of concrete in the future. This material will be used not only in small pleasure boats but in larger ships, by constructing a riveted steel skeleton to act as reinforcement. Such a structure ought to be just as practical to build as a reinforced concrete skyscraper.

BRIDGE WORK, BALUSTRADES AND ORNAMENTATION IN CAST STONE.

Moldings and stone railings for bridges and other forms of construction have lately been constructed in poured, reinforced concrete, and many engineers and contractors are familiar with the difficulty and expense connected with casting good, perfect monolithic concrete for ornamental purposes.

Stone ornamentation, manufactured in art stone, generally gives better satisfaction, if made under competent supervision by skilled labor, than cast monolithic stone. In most cases, too, there is a distinct saving in cost. Fig. 1 shows a typical section of an ornamental bridge rail or balustrade that will find frequent use. Figs. 1 to 12 show sections of the molds, giving the construction in detail.

In a job of fair size it pays to make the stone-work on the ground under a temporary shed or shelter, for the reason that cement and sand can be transported much more cheaply than the finished product. Moreover, art stone is likely to be damaged when it is hauled some distance in wagons and handled by unskilled labor.

For making the molds, a full-sized section drawing should always be furnished by the architect or engineer, and on this the details of the mold should be drawn, or a separate copy made. Men familiar with the general practice of machine pattern design should be employed for making the different parts of the molds. All plain moldings, like that in Fig. 1, main cornices, bases, balustrades and copings are best made of yellow pine.

Fig. 2 shows the section of a mold for the main cornice. The negative portions are constructed and put together in such a way that they may be removed piece by piece without disturbing the contents. The outside portion of the mold should always be constructed of boards of such thickness that they will not give under the strain of tamping. Clamping the mold to prevent it from spreading is of great importance. A band of strap-iron, placed around the mold, fitted with wedges to take up all the slack, is often necessary. This is shown in Figs. 2 and 3.

Before a wooden mold is used, it should be coated inside with two or three layers of shellac, and each coat, after it is dry, should be sandpapered. Fig. 4 shows a section of the base molding for balustrade. This is constructed on the same principle as the others, and the illustration shows a section of the mold, with a sand pallet, ready to turn over. All stones having a mold opening of from 12″ to 16″ may be turned over in a bed of sand, 6″ to 8″ thick, after the surface has been carefully leveled with a straight-edge. With larger stones, it is difficult to turn the mold over, since the cast is liable to slip out before the mold is completely turned.

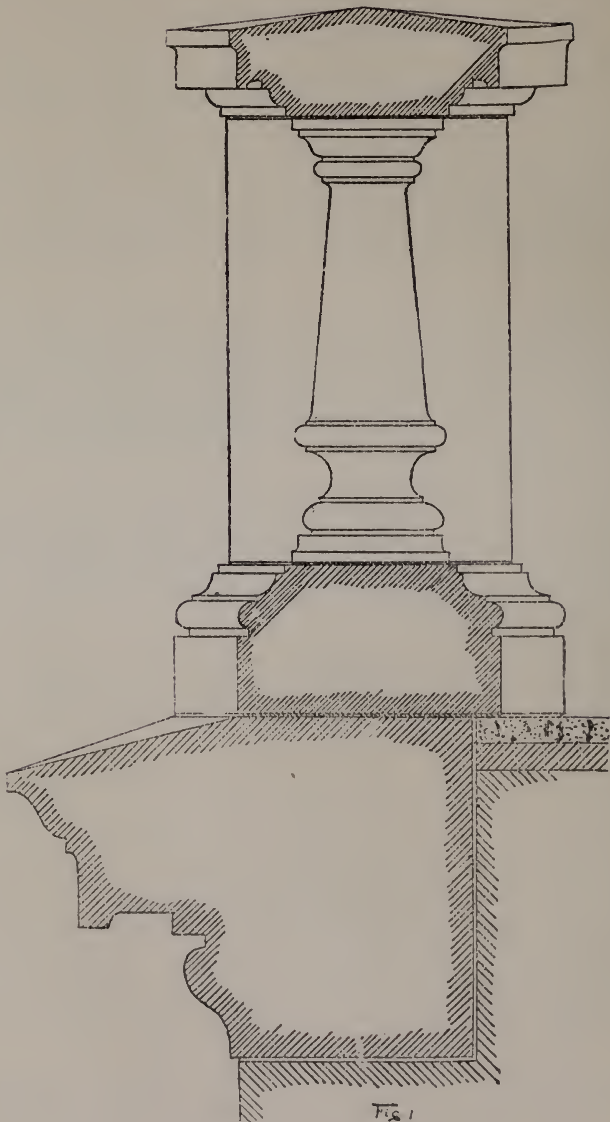


Fig 1

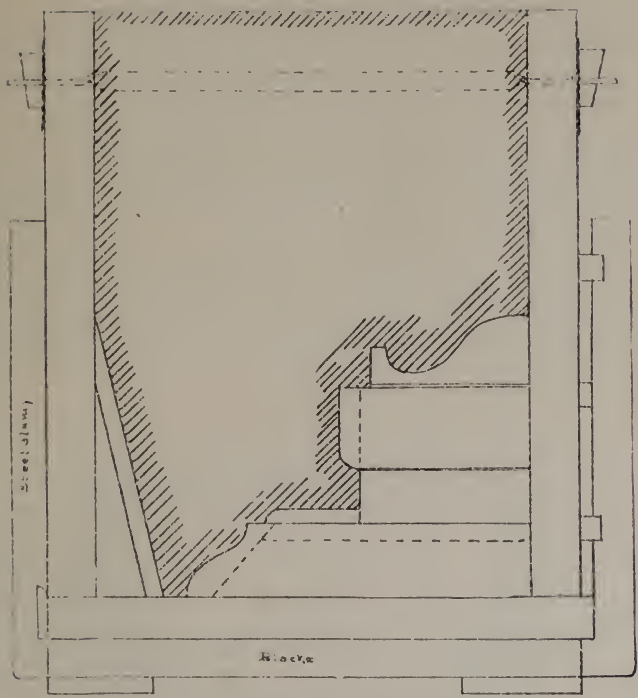


Fig. 2.

For this reason, fill on the top of the finished concrete about an inch of fine sand, and nail on a pallet at the top, as shown in Figs. 4 and 5.

MOLD FOR COPING.

Fig. 5 shows section of a mold for the coping of the balustrade. This mold is also built on the same principles as the foregoing, except that the

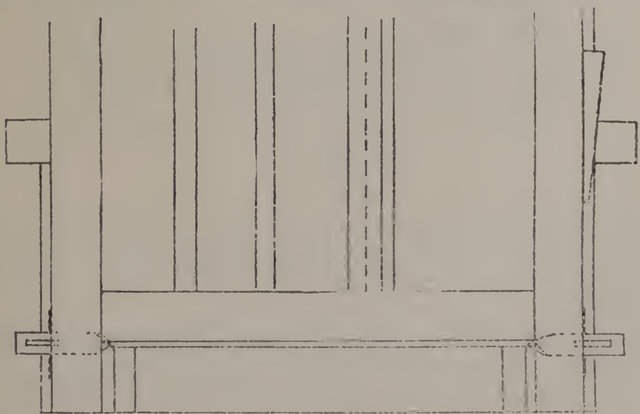


Fig. 5.

parts of the mold marked A and B are held in position with wood screws while the tamping and molding are being done. These screws are removed

as soon as the mold has been turned on a sand pallet, as before described. All portions of this mold may be removed immediately after turning, except the pieces marked A. The piece marked B may be removed immediately by taking the sand from under it, when this part slips down.

Before the part A can be removed, from two hours to a day are required for the concrete to set, according to the size of the stone. For this reason it is advisable to have several pieces of this molding made at a time, in order to permit continuous operation.

When the stone has hardened sufficiently, remove the sand from beneath it so that the mold will fall straight down as soon as the wedges holding the band clamp are removed. The thickness of sand on the pallet should always be greater than the depth of the waterdrip on the profile, so as to allow its removal.

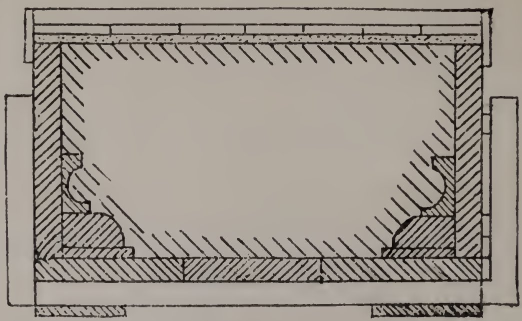


Fig. 4

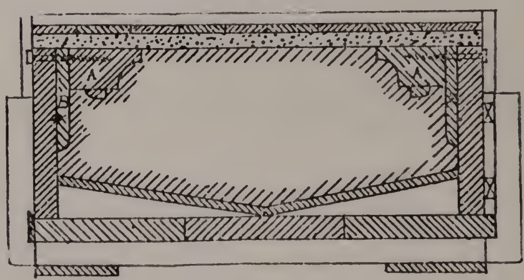


Fig 5

Coping with no bead on top can be more easily cast from the upper side, but this top, being finished by hand with the trowel, always results in an uneven appearance, even with the most careful work. It should therefore be avoided.

As soon as the mold is removed, repair all imperfections with an iron molder's trowel. Where corners are defective and not sharp, hold a piece of board, smooth finished, along one side of the corner and fill in the defect with earth-moist material. A little skill is required in repair work, but when the work is done while the concrete is still fresh, the joint cannot be seen later on. Any repairing done at a later stage has to be done with wet cement, and when it dries out always shows a different color.

In order to make the mold and model for balusters, a full-size elevation and drawing are required. From these are made a model in plaster of paris, and from the model a piece mold is made in the same material. Figs. 6 and 7 illustrate the process of making a plaster model for a balustrade with a circular draw mold. Fig. 6 shows the elevation of the model with draw mold, its construction and the method by which it is held in place to exclude variations in turning it around. Fig. 7 shows the same arrangement in the ground plan.

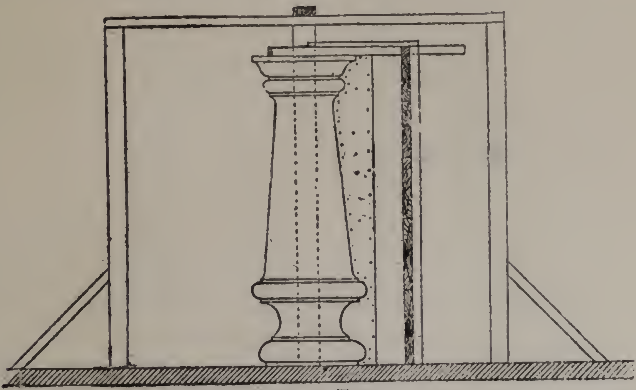


Fig 6

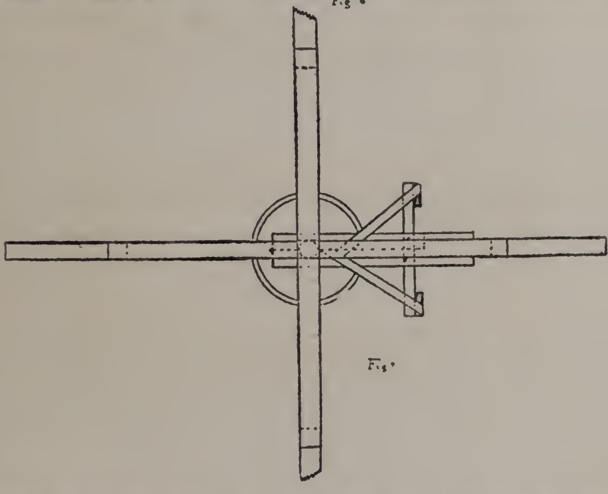


Fig 7

To make the draw mold, cut out from heavy tin or galvanized iron the negative part of the profile only the parts that are round; the square top and base are attached to the finished model later.

All edges of the tin should be carefully filed to a right angle with the plane of the tin. Then the tin is nailed to a wooden profile, beveled on one side at an angle of about 60 degrees. The tin profile should always project from $\frac{1}{8}''$ to $\frac{1}{4}''$ over the whole length. Cross-boards and braces are nailed as shown, in order to give the mold a secure guide on the table and exclude variations. In the center of the table fasten a center block, held in position by four outside blocks, cross-braced on top. The top of the draw mold fits into the center block, in a round notch, around which the

draw mold circles. The fastening is such that the mold may be removed for cleaning, during the process of "drawing" the model. For this purpose, the top board is made in two sections; one end is held together with a flat

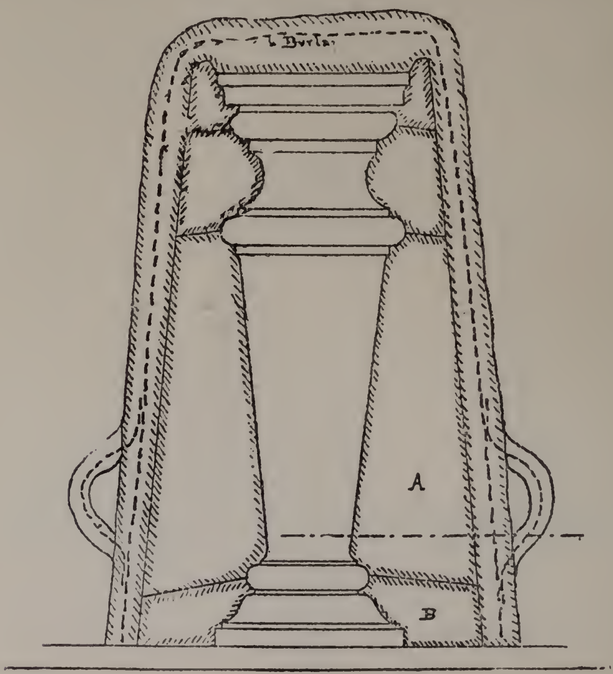


Fig. 8.

hinge, and the other end with a nail on top of the mold; the nail is removed by taking off the mold itself.

"SWEEPING OUT" THE MOLD.

When this frame and mold are securely in position, put plaster of paris around the center block and draw the mold over the mass to remove all surplus plaster. The plaster should be mixed to the consistency of syrup and permitted to stand until it assumes the consistency of mortar used in laying brick. This will take from three to five minutes.

To complete one mold usually requires several mixtures, because of the quick hardening of the plaster. When the mold is nearly perfected in all its details, use the plaster thinner, for the reason that a mixture of this kind hardens more densely and produces a smoother surface. When the mass prepared by moving the profile about it is completed, paste onto it the square head and base in separate moldings. These are easily molded in a wooden frame, and carvings or other plastic ornamentations may be readily added as required.

Cover the completed model with a coat of shellac and a thin coat of grease, to facilitate removal. The model is now ready for making a plaster piece mold, as shown in Figs. 8 to 12.

Fig. 8 shows a vertical section of the mold with sections for encasing cap; Fig. 9 shows the ground plan of the lower section. In beginning the manufacture of the sectional pieces, always begin with the pieces marked B, and divide the lower and the upper part, having a square plate as shown by the dotted line in the ground plan, Fig. 9. All other portions of the round section may be divided into three equal parts, as indicated.

Each piece is best molded directly against the preceding one, made ready and cut, each one being slightly greased to prevent adhesion of the sectional parts. Missing portions of the mold may be built in with the

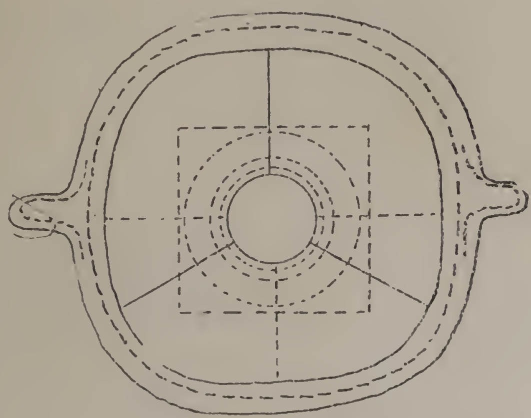


Fig 9

assistance of a small tin plate. When sufficient material has been put into one section, cut it with a knife or plane or saw it into the shape required, leaving the outside form in the shape of a conical object without undercuts, as illustrated in Figs. 10 and 11. It is advisable to insert a wire hook into each piece at the proper place, as shown in Fig. 12. This is left with a space around it so that the piece may be lifted with a hook, as shown in both Fig. 11 and Fig. 12.

After all the pieces are built up as described, smooth up the whole outside of the mold and cover the wire hook openings with clay, flush with the surface. Mark all pieces with running numbers, using an indelible pencil, covering the mold with a coat of grease and a plaster cap, as shown in the section, Fig. 8. This plaster cap is commonly made from 1½″ to 3″ in thickness, according to the size of the object to be molded, and should always be reinforced with burlap, cord or wire, to prevent it from warping or breaking. For ease in removal, it is well to attach to this cap some hand-grips, reinforcing them with wire, cord or burlap. After this cap has hardened it is easily taken off, provided the parts beneath it have been properly formed, as suggested.

When the plaster cap is taken off, the parts of the mold are removed one by one and all defects, air-holes, etc., are corrected with two or three coats of shellac. Each piece is now inserted in its proper position (following the indelible pencil numbering) in the plaster cap and the mold is now ready to be used. It should be filled and tamped with care, using the dry

molding process, in order to obtain a color uniform with the other parts of the completed work.

Should there be trouble in molding, owing to heavy projections on the

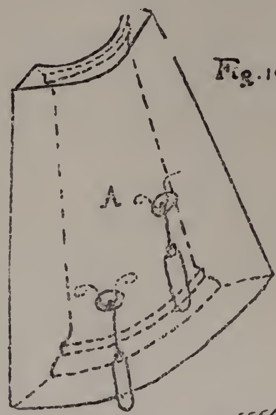


Fig. 10

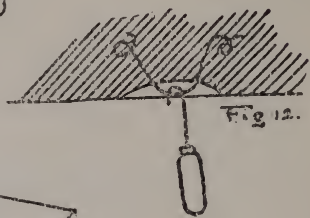


Fig. 12.

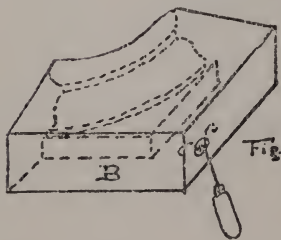


Fig. 11

balusters, leave the cast an hour or two in the mold. In case the mold is hard to remove, use inside of it a light coat of grease and petroleum.

Where there are heavy projections and ornamentation, with small details, it is best to use the wet process of molding.

MAKING PLASTER FACE PLATES FOR MONOLITHIC WALLS.

There are many classes of concrete work in which it is of advantage to use a special face design, for securing which there is no patented device available. For instance, an arch as shown in *a*, of the illustration can be used for a doorway, window, gateway or even for a mantel, and any special face design may be secured by the use of a plaster mold.

The following instructions apply only to the mold for the outside of the wall. The forms for molding the wall are set up in the usual way, the plaster mold being substituted for the plain boards on those parts of the exterior for which you wish to have special designs.

In following these instructions, the reader must keep in mind the difference between *model* and *mold*. When you wish to produce a certain design, say in concrete, you make a model of it. This model should be exactly as you want the finished product to be as far as size, form and surface treatment are concerned. Then a mold is made by pressing a plastic material over the model, letting it set and withdrawing the model. The hardened material holds the impression of the model and the model is discarded. You then use this *mold* in producing the work outlined.

The method of constructing the model is very simple. Construct a molding board about 12″ larger each way than the design you wish to model, and on this with rule and pencil draw the outlines of the block, of the same shape and size as you desire them to appear in the work.

Now drive lath nails into the molding boards so that they project about one-half inch from the surface, following the outlines of the blocks and placing same in from these marks two inches, so that the center portion of the design for each block is studded with these nails placed about one and one-half inches apart. These serve to hold the modeling mortar to the molding board if it is desired to move the model, just as lath holds plaster to a wall.

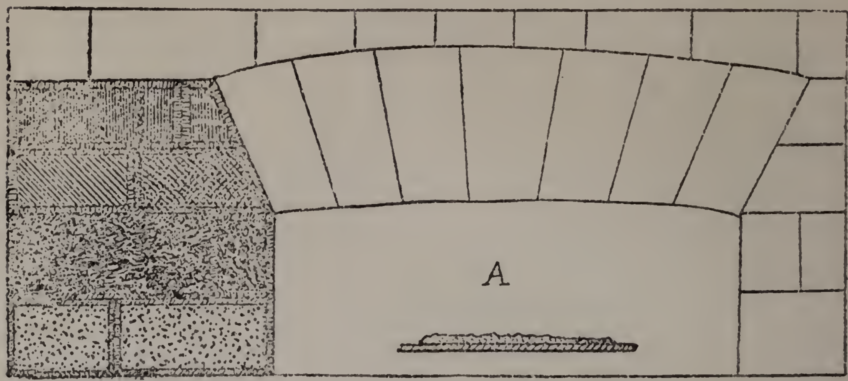
To complete the model, use sand or gravel mixed into ordinary concrete with Portland cement. For a fine-tooled surface use sand only, and for a rougher surface add coarse gravel to the mortar. For a rough rock-face employ crushed rock with the sand, using as much as it will carry.

Now with a trowel place this concrete on the molding board, building up one block at a time. Have the model high in the center, beveled or pitched to the mark you have placed on the molding board as a guide line. The method of doing this is shown in the small sectional drawing in the illustration *a*. You are, of course, guided in making the model by the character of the design and the smoothness of the dressed surface. The

mortar is smoothed down only enough to give it the desired effect, and if a very rough effect is required, small pieces of crushed rock are pressed into the mortar.

In this way you can construct the model for the entire arch, or other form, showing the division lines of the block with your trowel to give the effect of masonry. By making the model one block at a time you are able easily to follow the guide lines placed on molding board.

When you have the model designed to your satisfaction it can be moved anywhere, and any number of molds made from it, as the small nails hold



the concrete securely to the molding board. This model should be made to look exactly as you wish the finished wall to look.

To make the plaster mold, build a box form around the model as shown by *b* in the illustration; have this box at least 4″ higher than the model and 6″ larger each way. To reinforce the mold, stretch wires in the box, each way, as shown in the illustration, having them 2″ apart, or use a wire netting with that size mesh. This reinforcement must be placed one inch above the highest point of the model and fastened securely to the box form.

Now mix your plaster or wood fibre with sand, finely screened, using equal parts, and wet thoroughly so it can be poured into the box form onto the model. The sand and plaster mortar will pass through the wires and thus flow down, filling each little intricacy of the model and making a perfect mold. This is easily accomplished by having the wood fibre mortar very wet and by pressing it down with a plastering trowel after you have the box form filled to the top.

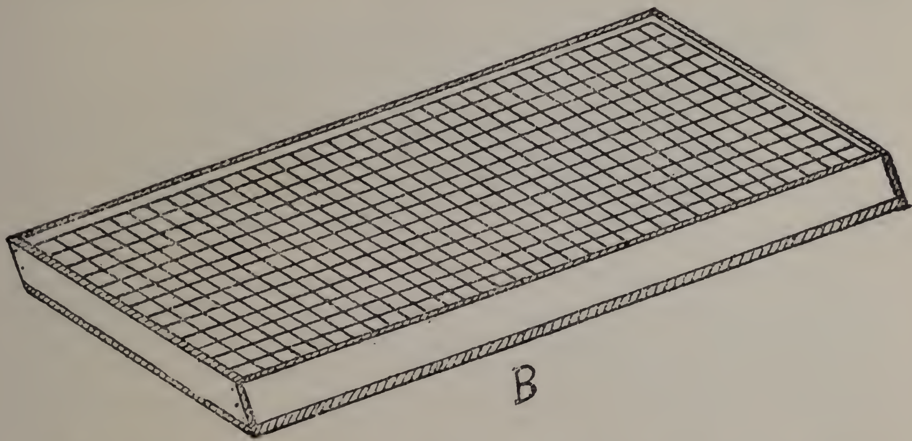
The mold, or face-plate, is now placed in position for molding, and the make the plaster mold to avoid any danger of the plaster sticking to the model and to secure a more perfect cast. As soon as the plaster is dry you can easily remove the mold, and if it is too large to use in one piece it can be cut into sections.

MOLD READY FOR USE.

The mold, or face-plate, is now placed in pisition for molding, and the other form boards are built up as usual. Then by coating the face mold with melted wax or grease each time, a large number of casts may be taken from each mold, securing perfect reproductions of the model.

In this manner you can make face plates for pilasters, columns and sections of walls, and, by using a number of face plates, mold the entire wall in any style of regular or random course block.

By employing finely screened sand for your concrete mortar in making the model, you can easily produce a good bush-hammered face, beveling it as you wish. In this same manner you can make a model of crandalled work by building the model to the height desired and then with the point of the trowel, marking lines diagonally each way over the face of the block, or model. By using a small grooved roller as employed in sidewalk work, the model can be given a broached surface, having the lines run diagonally across the face of the block and straight on the bevel. In this manner you can produce tooled work by having the lines made with the roller run straight across the block or model. To produce the effect of a patent-hammered finish you must cover the block with lines running straight across,



and then go over it again with the roller, so that the lines will be doubled, giving at least eight lines on the surface to the linear inch. In this easy and simple manner you can secure any tooled effect you may wish by simply making the lines with a trowel or roller on the model while the concrete is "green." While this requires considerable care and work, yet when the mold is made you produce almost perfect faces of the finest tooled finishes, as simply as molding a plain wall of concrete.

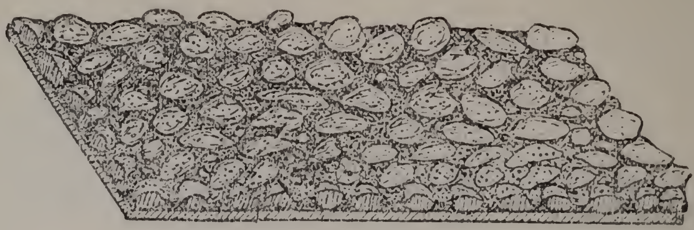
A pleasing effect may be secured by imbedding in the cement mortar of the model, small cobblestones, as shown in *c*, of the illustration.

A very pleasing mantel and fireplace can be built by using the arch model illustrated in *a*, with the face in tooled or crandalled finish to the shelf or ledge, which can be molded in a plain box form of the size desired and set in position when the concrete in the arch is sufficiently hard. Then place the cobblestone face plate above this and mold the chimney to the fireplace in the rough masonry effect.

STONE FINISHES.

For those not conversant with the different stone finishes, it is explained that in *a*, of illustration, are shown, as well as a line drawing

permits, the seven finishes explained above. The two lower block show the bush-hammered finish which leaves the surface full of points. This design is easily made by the use of a sharp, coarse sand in the concrete. The large block above this shows the rock-faced or pitch-faced work, and is made by using as much crushed rock as possible in the mortar for the model, and having the rough face extend to the line. The small block in the second course shows the vermiculated finish so dressed as to give it a worm-eaten appearance. It is secured by embedding in the "green" concrete of the model, irregularly shaped pieces of rock, previously greased, and removing them after the concrete has begun to set, thus leaving the indentations in the surface. The block with the straight, diagonal lines in the third course has the broached finish, which is made in the concrete with roller or trowel to



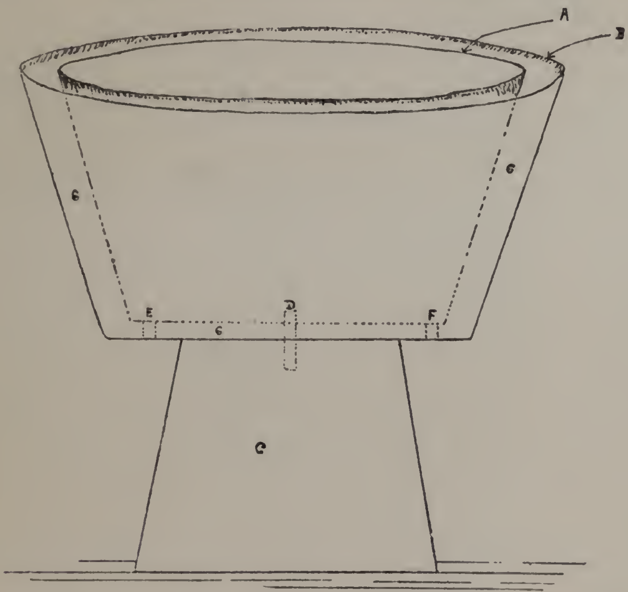
C

form the grooves. The block in the third course with the curved lines shows the effect of crandalled work, with the lines or grooves running both ways; this may also be made with the grooves slightly curved and running one way. This face is secured with the trowel point when making the model. The large block in the fourth course shows the effect of tooled work which is easily produced with the grooved roller; for patent-hammered finish, increase the number of lines or grooves so that they run from eight to ten to the inch. The small block in the fourth course illustrates droved work in which the lines are broken instead of running straight across the surface; this finish can easily be made by the use of the trowel point in making the model.

The above finishes with any other style or shape are easily made, when molding the model of concrete, as the modeling material gives you plenty of time to secure the right effect, a feature not possible when using a quick-setting material or one that is not permanent enough to retain its shape when making the plaster mold.

MAKING A PLANT URN.

A cheap urn for containing hanging plants can be made of concrete by following the accompanying design, submitted by A. Trowbridge, Lawrence, Mass. The base C is formed by filling a butter tub with concrete and inverting the block after it has set. The top portion is molded by placing a concrete floor in the bottom of a half barrel, B, placing a butter tub, A, inside and filling the space around it with concrete, G. Removable



plugs should be left in the bottom to provide for the drain holes, E and F. A wooden plug molded in the base and extending into the top at D, will give stability to the structure.

Mr. Trowbridge has constructed several clothes-reel stands by casting a heavy concrete block in a butter tub or other form, setting the pole or post supporting the reel in the form when the concrete is poured. The concrete base is then placed in the ground, the top coming to grade.

DIRECTIONS FOR BUILDING A FURNACE OF CONCRETE BLOCK.

The problem of heating during the long winter months is one that every concrete worker is interested in, and as the simple yet effective hot-air heating plant illustrated in this article is within the power of anyone to construct complete for a total cost of about $25 it should be of interest.

This furnace has ample radiation for heating a ten-room dwelling, or a store or factory of the same floor space, and to maintain an even temperature in all parts of the building.

As shown in the illustration, the main portion of the furnace is a large heating stove of the kind known as the "cannon ball" or shop stove, or may be any heating stove of the same design or method of construction. In this grade of stove the sides are from ¾″ to 1″ thick, making a stove that for furnace purposes is ideal. There is no danger of its "burning out," and this thickness of iron when once thoroughly heated remains hot for a long period with only a moderate fire in the stove.

The stove is first set into place in the most central part of the dwelling or space to be heated—i. e., in the cellar under the central room of the house; for supporting the stove, a concrete floor is laid of sufficient strength to avoid any danger of the concrete jacket settling and cracking.

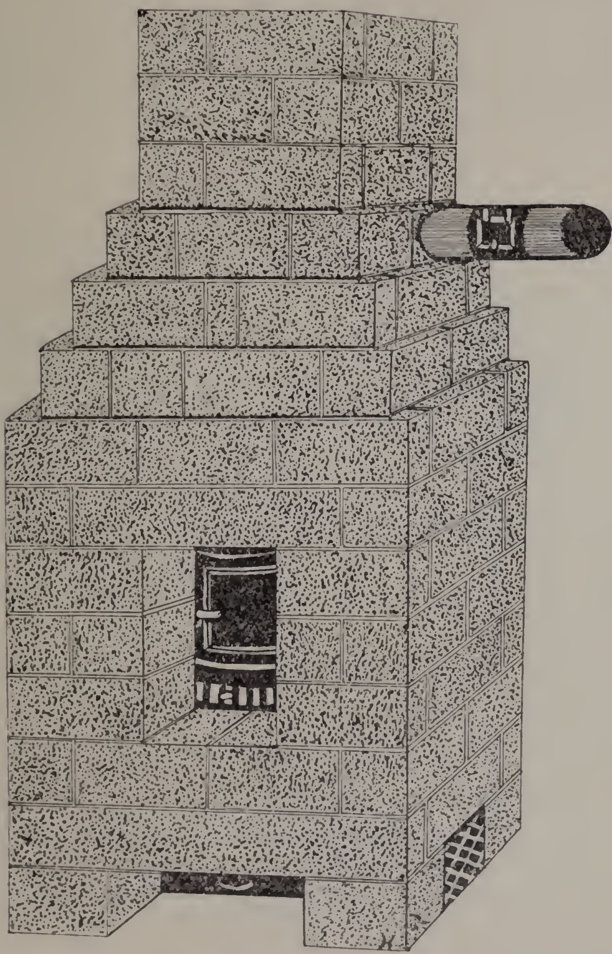
The jacket is laid up with concrete block as illustrated, a space being left in the bottom course through which the ash-pan may be taken out, also for cold air registers on the three other sides of the jacket. The latter should be at least 6″x8″ in size and may be laid up with the walls of the jacket and so securely fastened in place with the mortar.

Above the ash-pan a beam of concrete is placed. This should be molded of twice the length of two of the block used, so as to bridge the space rightly.

In the fourth course of block an opening is left sufficient to allow the draft and feed door in the front of the stove to be opened. The space between the stove and the wall of the jacket where this opening is located is filled with cement so as to prevent the heat escaping into the cellar, except such as is thrown out from the feed door.

With the seventh course of block another beam is used to bridge the space above feed door opening and the space between this and the stove cemented together, unless it is desired to have a door to close the feed door opening on the outside of the jacket. In this case, the space between beam and stove is left open so that the heat may be utilized.

With the ninth course of block, begin to draw in for the arch on all four sides until the inside space is 14″x20″. Then the jacket is laid up



Concrete Block Furnace

until it reaches the floor above, in which a hole is cut and a 14″x20″ register is placed.

For the stove-pipe opening, at the proper height, which of course depends on the stove used, place the heavy elbow on top of stove and use a length of extra heavy pipe to carry the flue outside of the jacket in one course of block. The opening around the pipe is easily filled with mortar so as to be air-tight, or, if desired, a block may be molded with an accurate opening for the pipe.

A check-draft is placed in the first length of pipe after it leaves the jacket. This may be purchased at any hardware store, riveted to the galvanized iron pipe, ready for use. The pipe or flue may then be carried on to the chimney in the cellar or up through the floors to a chimney in the second story, as desired. The latter method secures additional radiation.

HOW THE FURNACE WORKS.

When the furnace is ready for use, the heat is driven up into the room in which the 14″x20″ register is located. Then it travels in a natural course by the open doors to all the rooms of the first floor and from there through registers in the ceilings to the rooms in the second story.

The temperature of the room in which the 14″x20″ register is placed will not vary five degrees from any other room in the building, as the hot air in its natural course rises quickly to the ceiling and then travels to all the other rooms before dropping back to force the cold air in the room to the register.

The above method of heating is most economical and gives very good results, heating a ten-room house with less fuel than is needed with stoves in the usual way, as each unit of heat is utilized in the exact space needed.

The grade of stove mentioned may be purchased at the foundry for from $15 to $20, depending on the size. If one with a 20″ firepot is used, the cost of stove, registers, concrete and all the usual pipe, complete, will make the total cost about $25 for a very excellent and practical hot air furnace, one that will maintain the temperature of the average dwelling during the very coldest weather at from seventy to eighty degrees if desired. The slight care required twice each day is amply repaid in the even temperature maintained during the entire twenty-four hours.

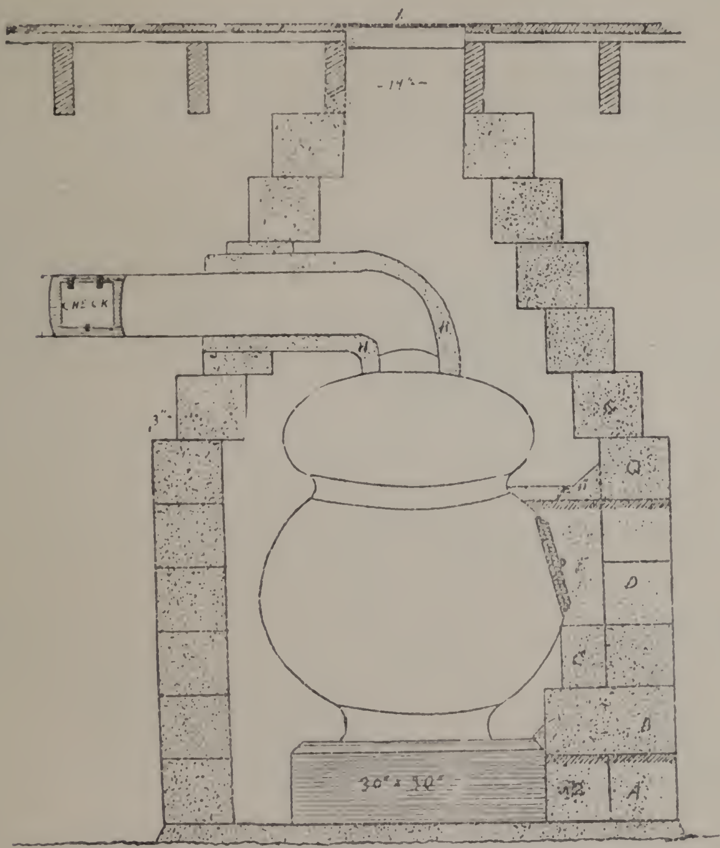
It is advisable that a door be constructed either of iron or concrete so as to close the opening left in the block for the draft and feed door in the front. This may have an opening for draft, and such an arrangement will save the small amount of heat that would otherwise find its way into the cellar through this opening.

While more expensive, if it is desired the dome of the jacket may be built closed at the top, using the regular furnace pipes to conduct the heat to the different rooms of the building; in any building where a large space is to be heated this is advisable, as it will permit an even temperature to be maintained and also allow any one room to be shut off from heating whenever desired, at a reduction of expense.

A dome for this purpose is easily constructed from concrete block by having the block where pipes are to be placed molded with an opening for them so that when laid in the wall of the jacket the openings are ready for

the furnace pipes to be put in position and fastened in place securely with mortar to make an air-tight joint.

In case of using furnace pipes to conduct the heat, the dome should be carried up higher before being arched over. In fact, it is advisable to make the top of the dome, after one or two courses of block have been laid above the top of the stove, either of beams of concrete laid close together and made air-tight with mortar or with a solid slab of concrete, reinforced, for the entire top. This will allow the pipes for heat to be placed very close to the top of the dome and thus secure the very best results, as the



SECTIONAL

heat is then quickly conducted to the rooms desired without losing a fraction of its heating power.

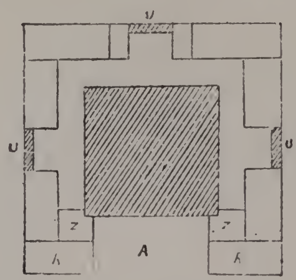
This practical and successful hot-air furnace is within the reach of every house owner, both as regards cost and ability to construct, and as it is more economical in fuel, heating the same space, than any stove, it should save the slight expense of its construction in a short time. Aside from giving greater comfort, there is nothing in its construction to prevent it from being as durable as any furnace constructed today, and where the space to heat is not too large it will do the work as well.

DETAILS OF CONSTRUCTION.

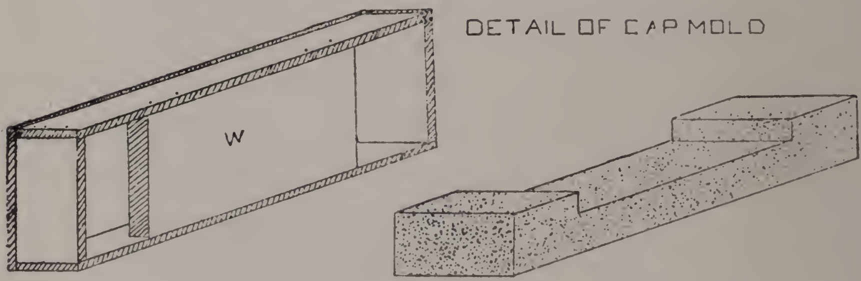
In response to a number of requests for a complete plan and details of the concrete furnace described, we have had prepared a working plan of this heater, which appears here, and now take up the method of construction in detail.

While the plan is drawn with the idea of using, mainly, a block that is 7½″x20″x8″, with half-block and several of a 16″ length, yet any size block may be used or even concrete brick—in fact any material to make the necessary "jacket" or enclosure of the heating stove.

The idea is simply to force the entire heat from the stove up into the room above, as is shown by the "sectional" part of plan, thus utilizing every heat unit where it will do the most service. This can also be accomplished by using regular furnace pipes, conducting the heat to the different rooms, as illustrated in the "front" section of the plan. This method is recommended where a large space is to be heated or a number of rooms, not closely connected, as in this way a greater radiation is secured, by con-



GROUND PLAN OF FURNACE



DETAIL OF CAP MOLD

ducting the heat to the room quickly before it has a chance to become cooled, as it would with the one-register plan, in a large dwelling.

For a small five, six or seven-room dwelling, the one-register plan works nicely, as the entire heat from the stove is given to one room in the house, the central one. From this room it naturally travels to the other rooms, and where the distance is short, with but little loss of heat units.

For the upper floor, registers are placed in the ceilings of all rooms; these must not be placed directly above the main register, but several feet to one side, in the central room, if you wish an even temperature in all rooms. By this method, the heat in its natural course ascends to the ceiling, driving out the cold air and warming the rooms of the first floor and from there

going to the second floor; by placing a register in the floor of each room in the second floor a perfect circulation of the heat is secured and an even temperature maintained.

As the stove used is of the "cannon ball" or depot style, with sides of ½″ to ¾″ in thickness, the result is that when this mass of iron becomes hot, it will retain the heat with but little additional fuel; in fact, there will not be 5 degrees variation in temperature in the twenty-four hours; this class of stove can be purchased at the foundry, at an expense of between $15 and $20—the size should be of at least a 20″ firepot for an ordinary residence, a slight increase in size for use where a large space is to be heated.

DETAILS OF PLAN.

As noted in the plan, a proper foundation must be laid in the basement floor. The location of this will depend upon the character of the soil and should be so laid as to make the distance right for the block to reach the bottom edge of joists.

As noted in "ground plan" the first course of block allows for the three 8″x10″ "cold air" registers, designated by U on plan. These are for the purpose of taking the cold air from the bottom of basement; they are laid with the first course of block.

In "ground plan," V shows the position of the base of stove; this is usually about 30″x30″ and is placed exactly in the center of the "jacket" or enclosure.

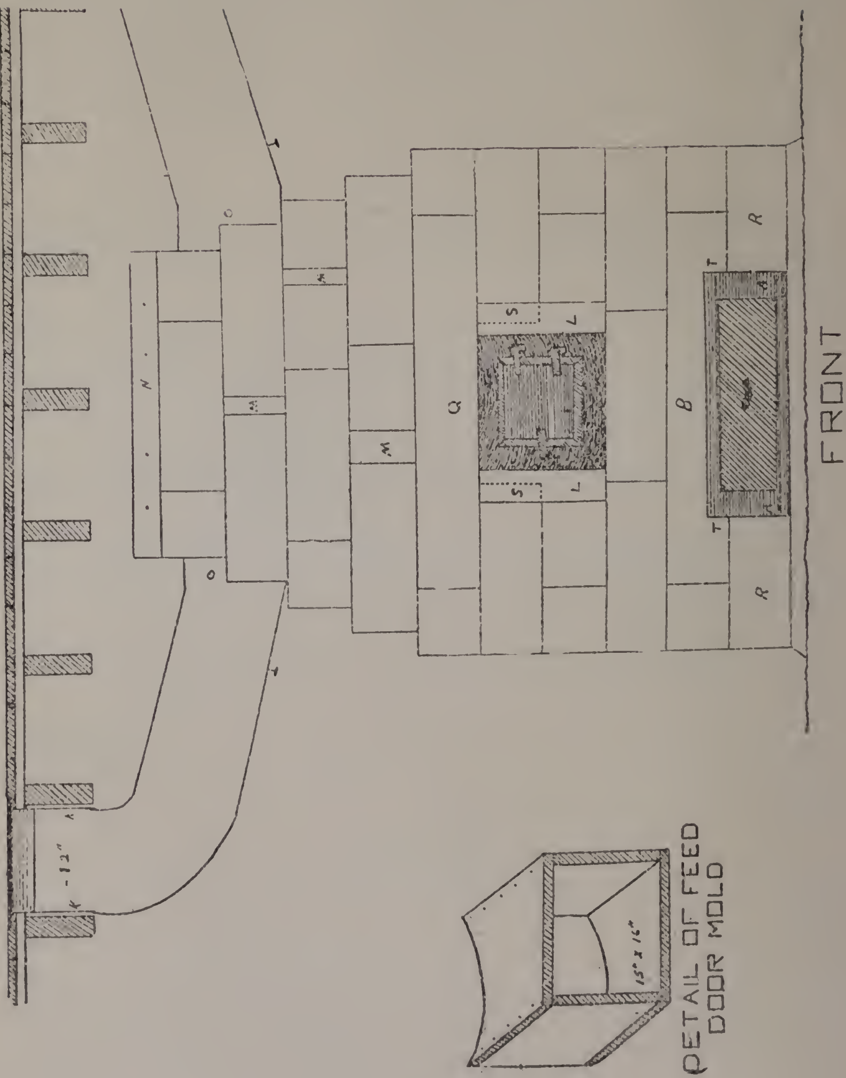
The outside measurements of the "jacket" are exactly 5′x5′. After the first course of block is laid, the space between the front course of block and the base of the stove is filled with concrete, designated by Z in plan.

At the front of the furnace, a 30″ space is thus left open in the first course of block, for removing the ash tray. This is shown by the letter A on plan, and for the usual stove will have to be 10″ in height.

The cap above this is designated by B on the plan; it is molded 7½″x 15″x44″ with a 2½″ space, as shown in detail at top, easily produced by a plank in the mold, as shown by W. The method of laying is shown by T in the "front" section of drawing.

After the next course of block is laid, the space to the edge of stove is filled with concrete as designated by C—this forms the bottom of the feed chute; this concrete filling is made only 24″ long and exactly to the edge of the stove. Above this, the "feed door mold" is placed. This is made from boards, 15″x16″, and long enough to reach to the stove; it is formed at one end, so as to fit up closely to stove; the block in the two courses in which this opening is, are laid, using two half-block; this leaves a 4″ space on each side of the "feed door mold;" if desired, upper block may project over as shown by S, as the space L will be filled with concrete.

Boards are placed on each side of "feed door mold" to leave a 4″ space for concrete; also board in front. The concrete is filled in up to stove on both sides as shown by E, and also on top, as shown by F, after upper cap, Q, is in position. This seals in the stove entirely, except the space around door with sufficient room to open the stove door to attend to the fire, and the ash opening.


FRONT
DETAIL OF FEED
DOOR MOLD
15" x 16"
Q
B
M
N
L
S
R
T
O
K - 12"

The upper cap, Q, is molded in the same mold as the cap, B, by using a center partition board. This cap is 7½"x8"x44".

In the next course of block it is necessary to arch the top; this can be done in a 7' space between floor and joists by drawing in 3", designated by G in plan.

As shown at H, the pipe inside the "jacket" is protected by a 2" coating or jacket of concrete. While it may be possible to buy a thick, heavy pipe to withstand the heat at this place, yet by taking one elbow and length of the 7" pipe and the same of a 10" or 11" pipe and placing one inside the other, then filling around same with concrete, it will be protected to withstand any degree of heat that will be generated.

In the last course of block next to the joists, the sides are set even with the course below; this will bring the opening at the top exactly 14"x20", to be covered by the 14"x20" register as shown at X; the sides of joists are to be lined with tin and asbestos, as indicated at K.

As shown in the "front" section of furnace, when arching the top it will be necessary to fill with concrete between some of the block, as designated at M; so it will not be necessary to mold short block for this purpose.

ARRANGEMENT OF PIPING.

Where pipes are to be used, the top is covered with a slab of reinforced concrete at the tenth course of block; this is 3'x3' and 3" thick, reinforced with ½" iron rods, two to the foot each way, as shown at N in the "front" section of plan.

The space for pipes is left in the dome, or the pipes are laid in with the block and cemented, as shown at O in "front" section. These pipes may be of any size desired. The plan shows the use of 12" pipes, using a 12"x12" register at Y—this will be found satisfactory for the ordinary dwelling.

When pipes are used, they are conducted to the main rooms of the lower floor, and registers are arranged in the ceilings of these rooms to heat the upper floor, as with the one-register plan; the furnace should be placed as nearly as possible under the central point of the dwelling, so that the lengths of pipe may be short; otherwise you will lose heat by conducting it too far before it enters a room.

As designated at R, the first course of block in the "front" section must be 16", if the opening is to be the full 30"—this can be determined by the width of ash-tray in stove used.

There is no question that this furnace will give excellent satisfaction for the ordinary dwelling, when properly placed, as the radiation of this class of stove cannot be equalled; in fact they are practically furnaces in construction, without the jacket, and this the concrete worker can easily supply at a small cost by using the accompanying plan.

HOW TO MOLD BATH AND LAUNDRY TUBS IN CONCRETE.

There is a good field for the concrete worker in molding different styles of bath tubs as well as laundry trays of concrete, and the first investment for the molds is very slight as they can be easily constructed at an expense of a few dollars and a little labor. The cost of the work itself is very low as but little concrete is required for these products, in comparison with other concrete specialties, and the margin of profit is at least reasonable.

A concrete plant producing these much needed articles would be doubly sure of success, as they can be made to sell at a much lower price than the present tubs of slate, porcelain and other materials, and still yield a large profit. With the variety of styles shown in the illustrations the tastes of every possible customer can be met.

As shown in the illustration, Style 1 imitates as closely as possible the regulation form of bath tub and makes a very neat article, although the most difficult to mold. Style 2 shows the tub molded in imitation of the expensive porcelainware and is easily constructed, the same core being used as in Style 1 and with the addition of a paneled outside form, square shape, the tub is molded with but slight addition to the first mold.

Style 3 shows a very handy bath tub where space is at a premium, as it is placed beneath the floor and when the trap door is down it does not occupy any room and is always ready for use at an instant's notice. The same core is used for this, with the addition of a simple square form to mold the outside edge.

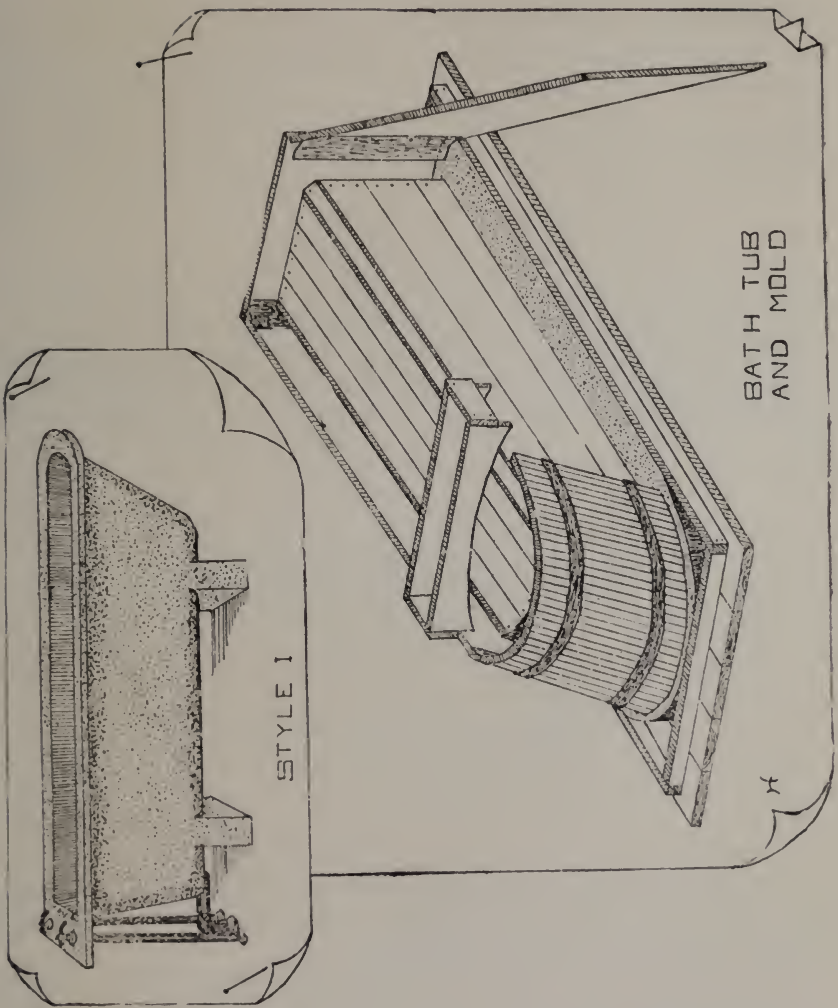
MOLDS FOR LAUNDRY TUBS.

This tub as illustrated is 6′ 8″ long, 28″ wide and 31″ high, outside measurements; this gives the walls of the tubs a thickness of 2″ and the inside dimensions of each tub 24″ square and 16″ in depth with the bottom of tub 3″ thick and standing, in the clear, 12″ from the floor. These sizes can be changed to suit needs.

A great advantage of this mold is in the fact that you can adjust it to mold one, two or three tubs together, as you may wish. By simply taking out one core form and moving the ends that much closer together you can mold a two-tub form and in the same way any other set desired.

For the core forms cut twelve 7½″ boards, 22″ long; fasten two of these together with cleats on the inside. On one side of these mark in 6″, on one side only, and then cut from that mark to the opposite corner so to draw in the one side of core that much, as shown in illustration.

Now cover these with boards, cut 24″ long, on the two sides, placing two ends together that distance apart; the bottom, which is shown upside


BATH TUB
AND MOLD
STYLE I

down in illustration, can also be boarded over in the same way or covered with a piece of tin.

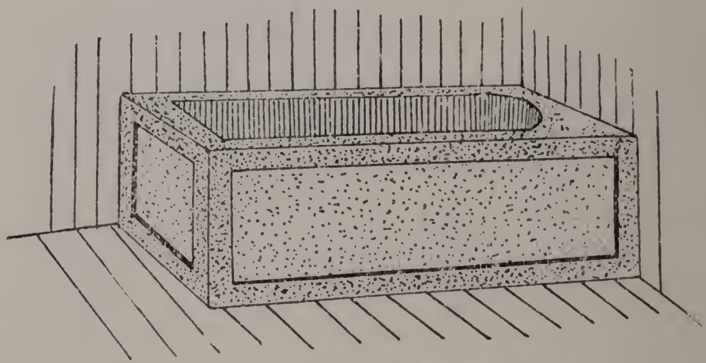
This makes each core form 24″ square at top 18″x24″ at bottom and 16″ deep, the inside size of tub, when one-inch lumber is used in the construction.

For the two sides of outside form cut four 10″ boards, 6′ 10″ long; fasten two of each together with cleats as shown in the illustration. This completes the two sides.

For the two ends of outside form, cut four 10″ boards and two 8″ boards, all 31″ long; fasten two of the 10″ boards and one of the 8″ together with cleats on outside. On one side of each end, mark in 6″ from one side and exactly 19″ from one end; cut along a line from each corner to the end of this 6″ mark; this is only on one side as the other side is left straight from floor up, so as to set the tub against wall if so desired.

For the two inside parts of ends, which mold the legs to support the tub, use two 12″ boards, 28″ long on one edge and 22″ on the other, so as to match the corresponding part of the end of the mold. This is hinged to a 6″x12″ board on the back, or straight side of mold, and to a 6″x12¾″ board on the slanting side as shown in the illustration.

The two ends are then hinged to the perpendicular side of mold, which is one inch higher than it need be and can be used so or planed down as you wish; the slanting side of mold is held in place by hooks and eyelets as



STYLE II

shown in the illustration. A 2″ hole is bored through one end in which a piece of gas pipe is placed when molding. This molds a hole in the concrete the proper size for the waste or outlet pipe.

The mold is operated upside down on a pallet; the cores are set in place and lightly nailed to the pallet; the outside form is then placed over same, as shown in the illustration; the form is filled with concrete, and, as it is molded upside down, all trowel finish comes on the bottom of the work. In filling the last stage of the form, the waste pipes should be placed in position and molded with the tub to make a satisfactory job.

In removing the work from the mold after the concrete has hardened sufficiently, turn the form over so that it stands upright; then the cores can be pulled out, with the aid of a handle placed on the inside of each core for that purpose. The slanting side of the mold is unhooked and removed and

the ends may be folded back from the work without the least danger of breakage, if the concrete has permanently set. While these tubs cannot be molded as rapidly as concrete block, yet the profits are large enough to make the business a desirable one.

The walls of laundry trays can be made any thickness desired by simply changing the sizes of the side and end parts. Any reinforcement can be easily used in the walls, as the position in molding enables the operator to reach any part of the mold to place the reinforcement. In building an adjustable mold, you can on one end use bolts instead of hinge and hooks, bolting through a projecting strip on the end. This will enable you to adjust the mold to a one, two or three tub size as desired.

This work is best finished by waterproofing and at least should be painted with a clear cement and water finish to give as smooth and perfect an appearance as possible.

MOLDS FOR BATH TUBS.

Bath tubs in styles 1 and 2 are molded top down the same as the laundry tub, using a pallet for the bottom of the mold. The size of style 1 is 6′ 4″ long, 36″ wide and 26″ high, over all. The inside dimensions are 5′ 6″ long, 28″ wide and 19″ deep. This gives a 4″ rim all around the top of the tub except on the inlet end, which is 6″ wide; the walls of the tub are 2″ thick on the sides and 3″ thick on the bottom. This allows the rim to project 4″ over one end and 2″ over the side walls; this rim should be at least 1¾″ or 2″ thick, but this dimension may be increased if so desired.

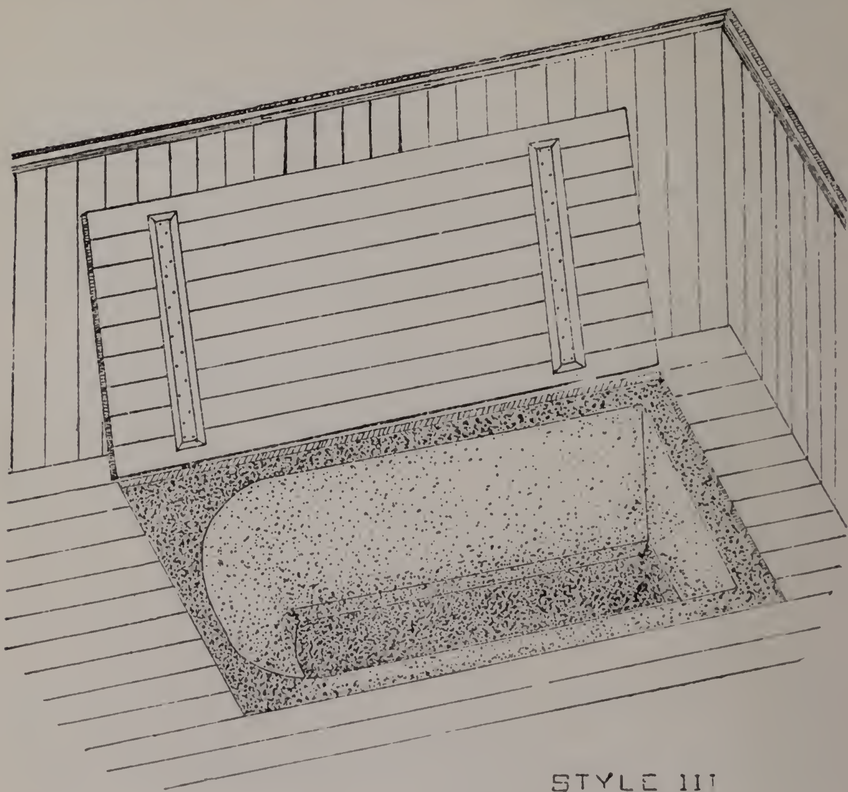
For the upright end of the core form make a square form 26″x18″, and on two corners of the core make a 3″ bevel. For the opposite end use two 12″ boards 26″ long, cut in convex form with the greatest width of convexity exactly 12″. Cover these with one-inch square strips cut 18″ long, having the strips even with the bottom form and one inch projecting above the top form. The form when finished should slant 6″ from the perpendicular so as to give that slant to the inside of the tub. This can be done by beveling the convex sides of the forms that the strips are nailed to. To complete the core, cover the bottom and both sides with boards of the right length; these will be of varying lengths to fit and must be cut to make the completed core form 5′ 6″, over all, at top and slanting to 5′ at bottom. This requires the bottom and side boards to be cut 4′ 6″ and then re-cut to fit into place properly to make the right slant to core. These boards are nailed to the outside edge of the convex form on the sides and to the 12″ convex board on the bottom, thus making all edges even. Bevel is boarded up as shown in illustration.

This makes the core form 19″ high at outlet and inlet end, and 18″ high at the upper end, to give the proper pitch to the bottom of the finished tub.

For the perpendicular end of the outside part of mold, make a form 22″x34″, to which the sides are hinged. For the two sides, build forms 22″ wide by 4′ 10″ long on one edge and 4′ 4″ long on the other, thus giving a 6″ slant to each end where it joins with the convex end of mold. These sides are cleated together and hinged to the perpendicular end, and

in the corners strips of tin are tacked to give rounded corners to the tub in molding; this tin strip is tacked to the sides only so the mold can be readily folded back from the finished tub.

For building the convex end of the mold, the easiest way would be to have two strips of strap iron bent into the proper form with a width between points of 34″ and a convexity at the widest part of 12″. These should have holes for screws drilled one inch apart and the strips of one inch lumber 23½″ long may thus be fastened on the inside of the iron bands, as shown in illustration. This form when completed has a slant of 6″ from the perpendicular, to correspond with the same slant given to the core form. An easier way of building this form would be to use heavy tin or zinc instead of the wood strips. Some light metal would not require so



STYLE III

many holes in the iron straps and could be easily riveted. This form would be lighter, and would turn out a smoother tub. If so desired, this method of construction could be used for the convex part of the core mold to advantage. In doing this, allow for the one-inch wood strips replaced by the tin.

The sides are connected to this slanting part of mold with hooks and eyelets, or a latch. These sides should fit closely so that the form will remain rigid and solid while the concrete is being tamped.

The feet of the tub are made by cutting four 6″ boards 32″ long; on one side of each cut out a concave form to a depth of 2″, as shown in the illustration, and join them together in pairs, with 4″x6″ boards at the ends. This is separate from the rest of the mold and is placed on top of the mold as soon as the tub proper is molded and the feet are then added. This foot form sets inside the mold, resting on the edge as illustrated. The cut shows but one foot form. By using the foot form as a separate part of the mold you are able to place the supporting feet on the tub at any point you desire and to have an ornamental form for this purpose, or several.

HOW THE RIM IS MADE.

For the rim of the tub build a square form of 2″x2″ strips, 6′ 4″ long and 36″ wide, inside measurements. This is placed on the pallet, as shown in the illustration, and at one end a strip of tin is bent around the two corners and down 12″ along the sides of this form, to form the rounded part to the rim of the tub. The illustration shows this in place, with the concrete laid for the rim.

In operation, this form is first placed on the pallet and the core form set in position and lightly nailed to the pallet. The concrete for the tub rim is then laid and the outside form placed on it and filled. The rounded edge on the bottom of the tub can be given with an edger, as used in sidewalk work.

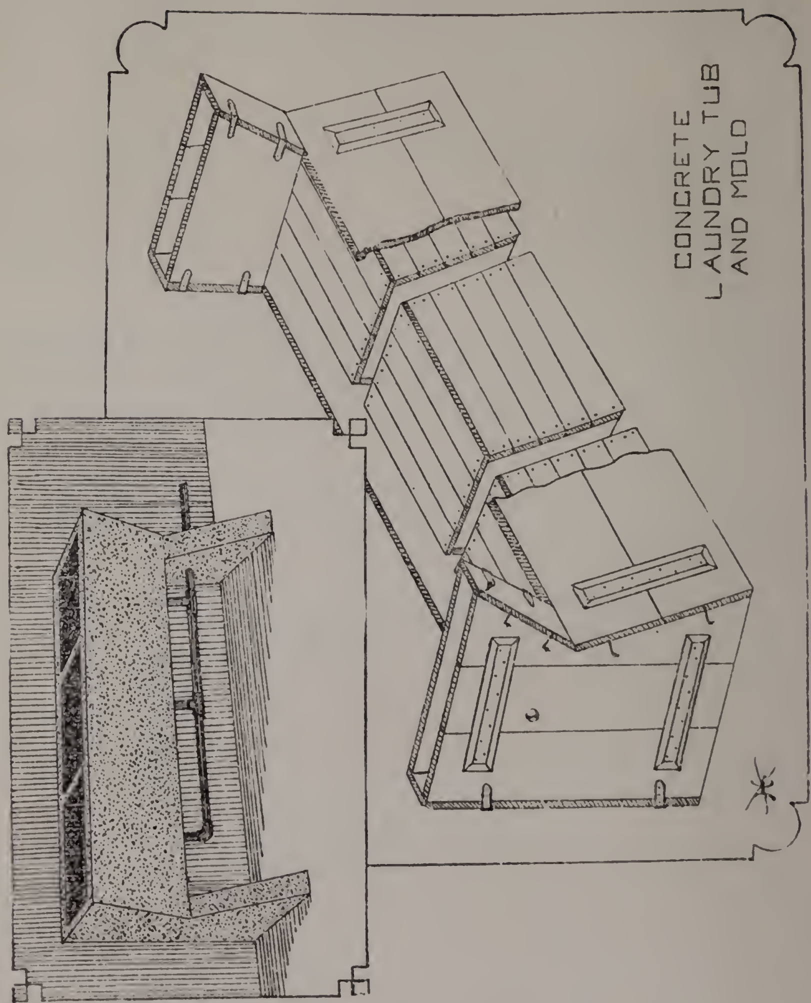
After the concrete has permanently hardened the foot forms are removed, the whole form is turned upright and the core mold removed. Then by simply unhooking the outside form and folding it back, the tub is ready for the waterproofing or clear cement coat.

This form also permits any reinforcement desired to be used in the walls or any part of the tub. While it can be used or not as desired, if the work is to be produced for a regular line, reinforcement is desirable in the walls and rim, as in this manner the weight of the tub can be reduced.

In Style 2, the same core is used and is molded with the mere addition of a paneled form which is built 6′ long and 34″ wide, inside dimensions. This makes the walls 3″ thick at the top, and 2″ thick where panels are molded.

This form is made in four pieces, hinged together at three corners, the fourth corner fastening with hook and eyelet. The panels are made by nailing to the sides and ends of this form, inch boards 17″x5′ 6″, for the two sides, and inch boards 17″x28″ for the two ends. These are nailed in the centers of the forms. This gives a frame 3″ wide around the sunken panel if the form is 23″ high, the proper height, which can be reduced to 22″ if desired. When the 23″ height is used, a panel may be molded in the bottom of the tub in the same manner as for the sides, to allow the outlet pipe to be connected through the floor of the bath room, instead of coming out the side of the tub, as is usually done with this style.

This style of tub is a very good substitute for the expensive porcelain tubs, in shape and service, if properly molded, and has another advantage in being produced with less work than the regulation shape. In fact, the forms for this style can be removed before the work has permanently set, as is done in molding concrete block.


CONCRETE
LAUNDRY TUB
AND MOLD

This tub can be made a work of beauty if white cement, with an aggregate of marble or white sand, is used and will command a ready sale at a good price.

TUBS MOLDED UNDER FLOORS.

Where the space is limited, Style 3 will appeal to all, as it places the bathroom in any desired part of the house without taking up any floor space, and allows the tub to be used and then covered.

The same core form is used for this as for the other styles described here. The walls should be at least 4″ thick and for convenience may be 6″ thick, as then the floor of the room can overlay on the edge of the tub.

A good foundation or sub-base is laid, if the tub is to rest upon the ground, and the tub is molded by laying the bottom of tub, resting the core form on this and filling in the concrete for the walls. As will be noted, this style must be molded top side up to be done easily under ordinary conditions. The necessary details of this style may be noted in the illustration and from the specifications of the other styles.

There should be an exceptionally rich field for the concrete worker in this branch, as he is not compelled to compete with a material that is nearly as cheap, but can make this class of goods and sell, if he wishes, far below the usual prices asked for the iron, steel, porcelain and enameled goods, still making a satisfactory profit on his investment. If properly made, there is no doubt that reinforced concrete can fill all the requirements demanded, as its successful use in swimming pools, tanks, cisterns and other receptacles for holding water will prove. The concrete should be mixed wet, and care should be taken to secure well graded aggregates. A waterproof compound may be added to the mixture, or a waterproof coating applied to the finished products.

METHODS OF MOLDING ORNAMENTAL FLOWER POTS, VASES AND URNS IN CONCRETE.

For the concrete worker there is no field that offers greater possibilities for successful business than the manufacture of reinforced concrete flower pots and similar articles, and as the investment is very slight their production can easily be operated as a side line, with the easily constructed molds illustrated and described in this article.

In ornamental concrete work the wood mold is possible only where we have a nearly square shape; otherwise the labor of construction would be beyond the power of the average worker; I have illustrated such a mold as can easily be built and will work rapidly and with good results, and one that produces a very neat, simple product.

In the line of waste molds, the worker has a greater chance to increase the ornamentation of the product if he can neatly model in clay and from this model make a cast or mold in plaster of paris, glue or plaster. In my experience in this work I have always secured the best results with the plaster mold. It is more durable, can be cut into sections with a saw when the common brand of prepared plaster is used, and forms a mold from which a large number of casts can be made, in every way being most excellent for this purpose.

When the mold is made from plaster, the cost and labor of making is very slight. This enables the operator to have a number of different designs, and increases his chances of pleasing his customer.

When an urn is molded in a square or round shape and set on a square pedestal, it will, with the addition of a name plate, make a very pretty memorial that is highly pleasing as well as serving a double purpose. It is, of course, possible to secure somewhat more elaborate and very pleasing effects with manufactured molds.

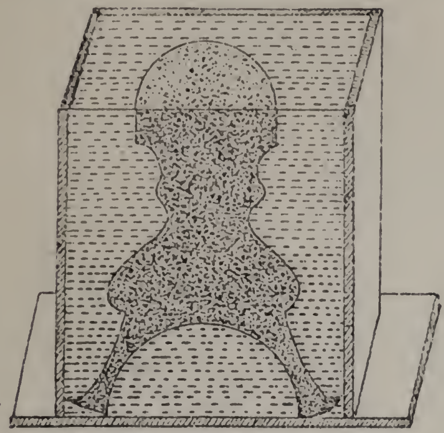
Such a design is excellent when molded with a combination of marble flour, white cement and sand, or with crushed granite as an aggregate. If the work is properly done, the result should be worthy of a position in this most profitable field. By molding the pedestal with four of the expansion bolts at the correct distances apart on one side, the name plate can easily be attached to the pedestal when ready to place in position.

The name plate can be molded in a shallow box form of the size desired and the name and dates neatly imprinted in the concrete before it hardens. With the letters colored with some dark pigment or inlaid with gold leaf there should be made a very tasty memorial and one that will command a good price, as there is nothing in cut stone to equal or to compete with it at the same cost. The maker would also have the advantage of

being able to fill his orders before the stone could even be dressed, without considering the difference in cost.

MAKING MOLD FOR SQUARE ORNAMENTS.

When the mold is made of wood, a box form is built 24″ square on the outside, and 28″ high. The four sides are not fastened together but are hinged to the bottom board, as shown in illustration. As the 24″ measurement is outside, this would give an inside dimension of 22″ square,



SECTION OF PLASTER MOLD

if one-inch lumber is used in construction. This size is taken only as an illustration and can easily be changed to suit individual tastes or needs, when building.

A 2″ bevel molding is nailed around the bottom board, mitered at the corners, as shown. This is not fastened to sides as it would not then allow sides to fold down without injury to concrete.

Now prepare four pieces 22″ long and 10″ wide by 4″ thick. This can be done by tacking several boards together. Plane these into a convex form, to a point or sharp edge on one side and the opposite side the full four inches wide as shown at A in sectional illustration of mold. These four pieces are mitered square at each end and nailed to the four sides so the sharp edge is exactly 2″ up from the bottom.

Now cut four pieces of hollow or Scotia molding 2″ wide on the face. These will have to be cut 16″ long if the material is one inch thick. Miter them to fit together in a 14″ square in the inside and nail just above the piece A on the four sides of mold.

The space between this molding and the sides may be filled with strips of board to fit so as to make all solid.

Four pieces are now prepared 22″ long, 6″ wide and 14″ thick; these are planed down in a concave form, to a depth of 3″, on one side only, as shown at B in sectional illustration, and are then mitered and nailed to sides above the last molding.

A one-inch hollow or Scotia molding is now cut to go above this. This will require each piece to be cut 10″ long and mitered to make them 8″ square, inside, when fitted together; these are nailed above piece B and the open spaces between B and the sides are filled with pieces of board, cut to fit.

Piece C is cut the same length, 22″, and is 14″ thick and 4″ wide; this is planed down on one side in a convex form to a depth of 3½″ and when mitered at each end is nailed to sides as shown in illustration.

For part D, cut four pieces 22″ long, 3″ wide and 3½″ thick; miter them at corners and fit them above piece C, completing the four sides of mold and giving the base a measurement of 15″ square.

For the core or form to mold the hollow in top of the piece, cut two pieces 18″ long and 7″ wide, and two more, 16″ long and the same width; on the latter miter in from each end 4″ and on the 18″ boards cut miter in 4″, on each end. These are fitted together to make a form 18″ square at top and 10″ square at bottom; the bottom is then boarded over with 10″ boards as shown in illustration, completing the core. It is then fastened to the bottom board of mold so that it remains always in position.

USING THE MOLD IN WORK.

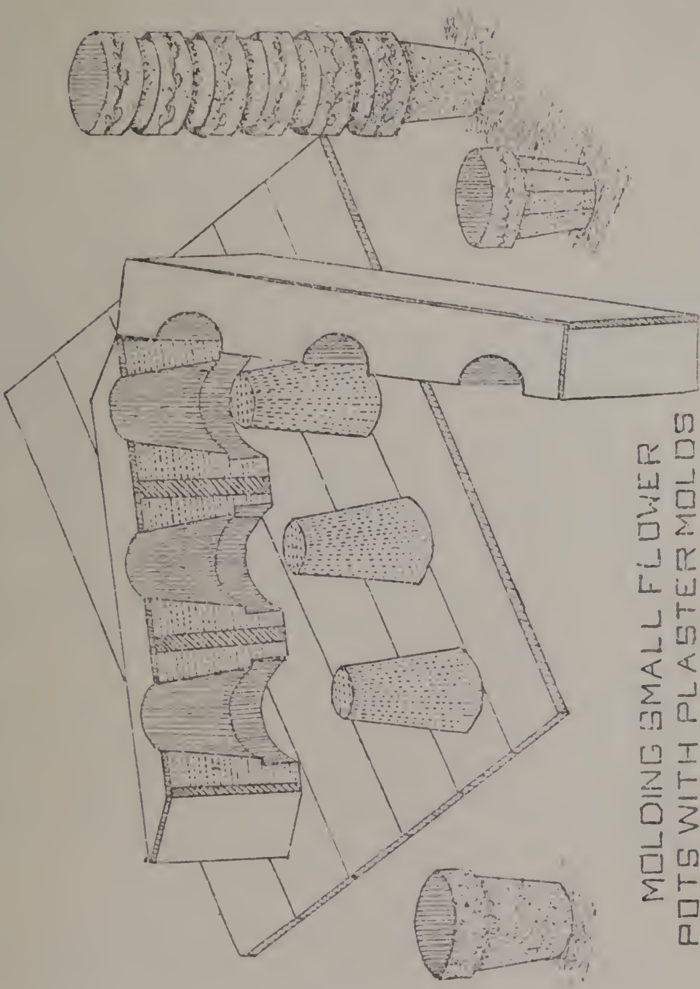
To lock the mold together before using, cut four 3″ strips 28″ long; on each end of these strips cut a notch into them 2″, with the notches exactly 24″ apart. Nail two strips securely to the sides of mold, on opposite sides, and fasten the other two with a bolt in center to the other two sides of mold, so that they will lock together tightly, as shown in the illustration.

This gives a secure and easily made method of locking the mold together and permits it to be held rigidly in position and absolutely square, if the notches are correctly cut in the strips.

In operation, after the mold is filled and to remove the cast, it is only necessary to turn the mold over, setting the urn upright upon its base. By unlocking the locking strips the four sides may be folded back from the completed work without the least danger of injuring the concrete, and the method of operation allows the work to be done rapidly and easily.

As the work is molded upside down, any reinforcement desired may be placed in position while filling the mold, as any part of same is easily within reach of the hand of the operator. As the work is square, it also allows almost any style of reinforcing material to be used. For the upper part of urn wire netting is considered to be best as it binds this portion more strongly together, thus securing greater strength to bear the strain which falls upon the weakest part of the work.

It is advisable that the urn shall be molded in sections as it will be very heavy if of any considerable size, and as it must be turned over to remove the dirt placed in same and in winter to prevent water standing in same and freezing. This can easily be done by filling mold up to the first narrow molding with concrete, and then laying on same a sheet of tarred paper, cut to fit into the mold at this point, then filling with concrete to top; this divides the concrete neatly and correctly and allows the top or bowl part of urn to be removed at will.



MOLDING SMALL FLOWER POTS WITH PLASTER MOLDS

Where it is desired to have iron pins to join these two parts together when in use, place them in the concrete when molding. Do not have these pins too long, three inches is ample, and coat pins well with grease before setting into concrete; this molds the holes in each section of the urn and also allows the same pins to be used for joining same together.

While it is rarely done, a very good improvement would be to mold in the sides of bowl a small hole, penetrating up into the inside part of bowl so that surplus water would run away and not accumulate. This is easily done by boring a hole diagonally down through piece A and also through core, filling the hole with a rod when molding, which can be removed before drawing mold.

MOLD FOR THE BASE.

For the pedestal mold, build a box form the same as for the top 24″ square, outside, and 22″ high. Have the four sides hinged to the bottom and held together when molding with the same system of locking strips as used for urn mold.

The pedestal is also molded upside down. This insures that the top will be perfectly true and level.

To secure the shape illustrated, cut four pieces 22″ long, 2″ thick and 3½″ wide; plane each one down on the edge so as to make a bevel and miter so that they fit together, nailing to bottom board of mold, as illustrated.

Now cut four 2″ square strips 22″ long and bevel on one corner, miter and nail to the sides so that the one edge is just 4″ from the bottom. This gives 2″ between the two strips, the one fastened to bottom of mold and the one on sides, which molds the upper ledge of pedestal to that width on edge.

Four pieces are now cut, 22″ long, 10″ wide and 4″ thick. These are mitered and fitted above the bevel molding, just placed in position, and this is capped by another bevel molding 2″x2″ and 22″ long, as shown. These are all mitered so that they fit together closely when the mold is fastened together with locking strips, ready for mortar.

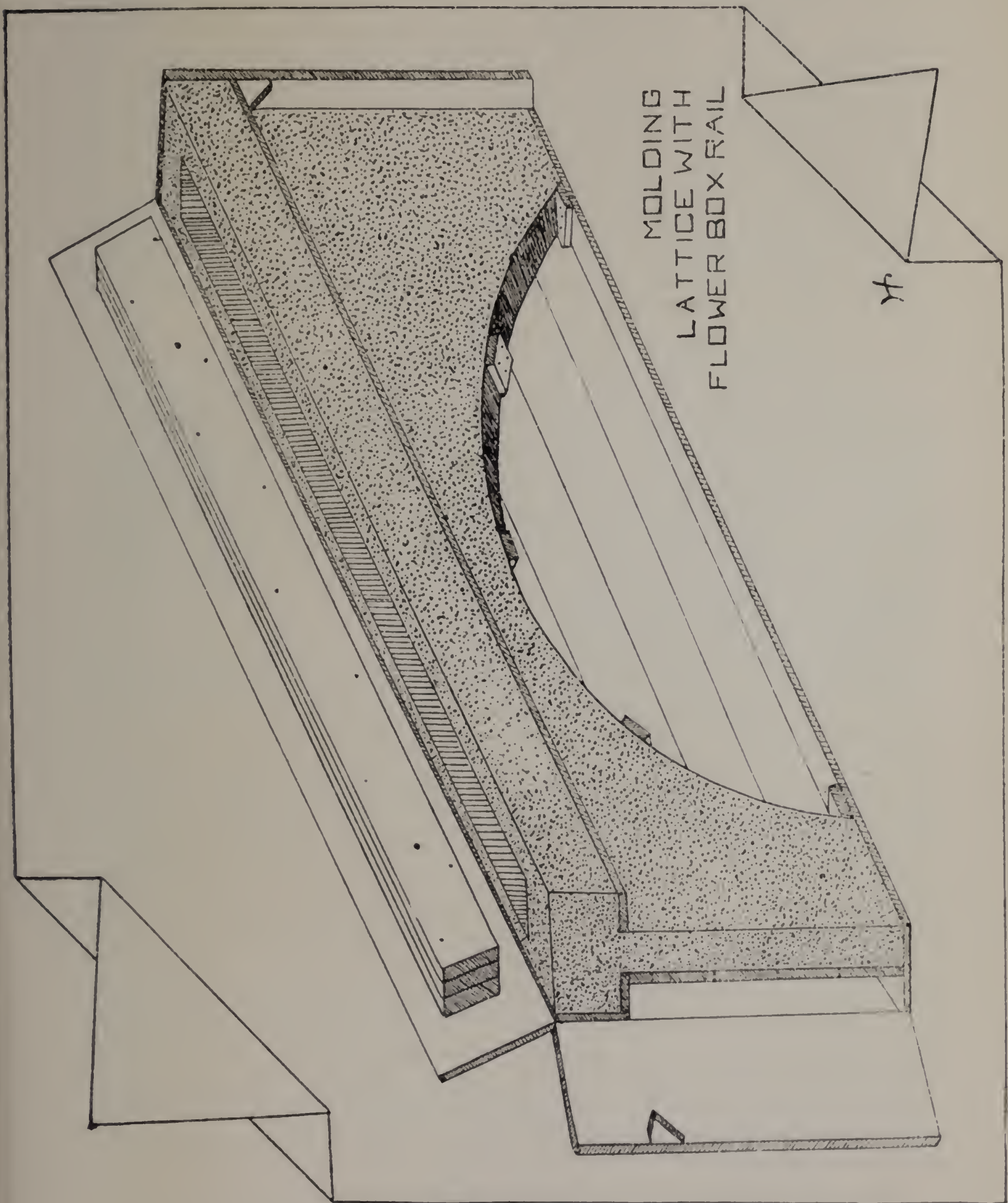
For the panels, cut four boards 6″ x 12″ and one inch thick, bevel on each edge and cut the corners concave so as to make a neater effect in the panel. These are nailed to the four sides upon the projections, as shown. These panels would look fully as neat if cut in diamond shape or in any other shape that is desired. This completes the pedestal mold ready for operation and it is fully as easy to use as the mold for the top.

MODELING ORNAMENTAL MOLDS IN PLASTER.

If the maker is able to work out his own ideas in a clay model, he can produce excellent effects in ornamental work of all kinds with the plaster mold.

The bowl of a vase, for example, is first cast with the plaster by simply filling some large pan with the latter and when dry placing it in position on the modeling board. Over this, the plastic modeling clay is built up in the form desired for the work, and this is then oiled or coated with grease and a box form built around it, as shown in sectional illustration.

The space around the clay model is then filled wth a solution of common plaster, the prepared brand, such as is sold for wall plastering. This


MOLDING
LATTICE WITH
FLOWER BOX RAIL

dries quickly and can easily be cut with an old saw down through the boards, plaster and model, dividing the whole thing into halves. The clay is then removed from the mold and the inside of mold treated to several coats of shellac and then fastened together with hooks on boards, when molding. By oiling the inside of mold slightly before using or applying a thin coating of paraffine wax to it, there will not be the least danger of the work sticking. This will not happen unless there is considerable undercutting in the ornamentation, which can be easily overcome by dividing the mold into quarters if it is necessary.

For this class of work a very wet mix is best so that it can be poured and reach all parts of the mold to fill them completely. For tamping purposes when needed a small oval piece of wood about one inch thick works nicely. If this has the same circle as the main body of the work it is easy to force the mortar down quickly and solidly.

MOLDING SMALL FLOWER POTS WITH PLASTER MOLDS.

For these molds a box is built of the exact height of the jar or pot that it is desired to mold. This is made of the proper length so that from one to a dozen may be molded at one operation, as desired. In constructing the box, allow a space on sides of at least 2″ larger than the pot to be molded, for the plaster; then divide off the box with a partition between the molds, as shown. If it is desired to mold pots of 8½″ diameter and 8″ high, have each partition of the box so as to make the inside measurement 12½″ square and 8″ high; in the center of bottom cut a hole of the exact size of the bottom of the pot to be molded.

After driving a number of small nails into the inside of the box to help hold the plaster in position, set a common clay flower pot of the size you wish, with the bottom resting in the hole in bottom board and fill mold with the prepared plaster; after this is dry pressure upon the bottom of the pot used as a model releases it, if it has been greased before the plaster is poured into box. After the pots are removed, cut the mold into halves with an old saw, and hinge them together at one end, fastening the other end with a hook and eyelet when in use. This prepares the outside part of mold for use and as it is easily taken apart without injury to the concrete the work can be molded rapidly. This same plan permits production of ornamental work by securing some clay pot of pretty design and using that as the model in constructing the mold.

The cores are made in a more simple manner. Take the pot to be used as a model and fill with the plaster. Have the inside of model well greased and the core is molded with ease, and at a small cost, so that it will be possible to make a large number of cores, and thus be able to leave the concrete on the core until it hardens, when it can easily be removed. This gives the advantage of being able to mold a large number of pieces each day, as many as there are cores for.

It is advisable to coat the inside of molds and cores with several coats of shellac so as to prevent sticking of the mortar and to make the plaster waterproof, or nearly so.

This system is operated as shown in illustration, with the top, or open part of the flower pot, down when molding, the outside part of mold folding away from the completed work.

A strip of iron 3″ wide, bent at one end into a semi-circular form, makes an ideal tamper for this work as the shape allows it to be easily used in the space and the mortar can be forced to any part desired.

HINTS ON DOING SMALL WORK.

When molding small work of this kind, a saving of time is effected by turning the mold top up, with the bottom resting on a pallet. Fill it with soft, wet mortar and then force the core down into this, causing it to press up against the sides of mold. As the work is usually molded with a hole in the bottom it is easy, by inserting a wooden pin in the core when modelling, to have a guide in pressing down core, for when the wooden pin touches the pallet and the sides are even it is only necessary to smooth off the top edge to have the pot molded complete. While it would cause more work in construction, a lever could be arranged to force the set of cores down even and true into the outside part of mold at one operation. This would increase the number possible to mold besides lightening the labor, but for the average worker would not be required.

In the use of plaster as a molding material, it should always be used very wet, so that it may be poured into the form and thus every cover every ornamentation on the model, producing a better mold.

These small pots may be reinforced with wire twisted into rings of the right size so as to come in center of the work. These rings may be joined together with upright wires to make a cone-shaped frame for the entire work. This is advisable only in the event of work that commands a good price, for in order to compete with clay work the cost must be kept at a low figure. A good price should be secured for a neatly ornamented flower pot molded with white cement, marble flour and white sand.

MOLDING LATTICE WITH FLOWER BOX RAIL.

A very neat effect can be secured by molding a box for flowers on the rail of a lattice or curtain wall of a concrete veranda.

The size of mold will of course depend on the distance between pilasters, but the mold itself is generally constructed in the manner shown in illustration.

The pallet or bottom is the main portion, and to this the top and two ends are hinged and the foot board is fastened. The projecting rail is molded on one side by the construction of a pallet as shown in end of illustration, and the opposite side of rail is molded by the board held in place by projections on end boards. Ends and side board are held together with hooks while molding the lattice.

The core of the flower-box is made of several pieces of board nailed together as shown in illustration. This is fastened to the side board with two bolts and thumb nuts so as to allow them to be unscrewed before folding the side down, when the core of flower box can be lifted without injury to the concrete.

The mold is operated with bottom down and the lattice is removed by simply turning over and unfastening hooks, etc., folding the mold away from the completed work. The section of curtain wall below flower box can be molded as desired, with an arch as illustrated, or in any other manner. This makes a pretty effect for the concrete veranda.

MAKING REINFORCED CONCRETE BENCHES FOR GREENHOUSES.

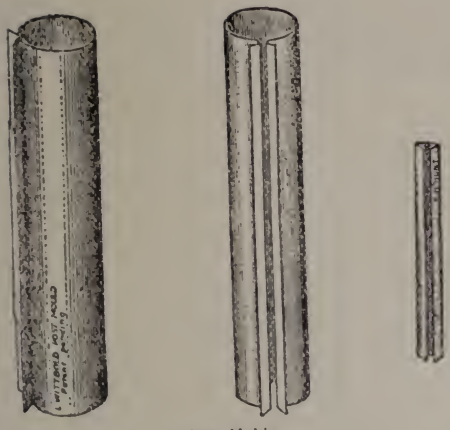
One of the greatest items of expense about a greenhouse is the upkeep of the benches supporting the flower beds. Until very recent times these benches have been constructed of wood which rapidly deteriorated under the action of the water and the earth mold. The increased price of lumber and the trouble occasioned by disturbing the beds in repairing benches has led florists to look about for a new material. Concrete has been tried and has proven successful in meeting the condition. A properly constructed concrete bench will last as long as the greenhouse itself, or longer. Robert Simpson, Clifton, N. J., who is growing roses on concrete benches, says there is no difference between the stock grown on concrete benches and that grown on wooden benches, under the same conditions. This is also true with carnations, bedding, bulbous and decorative stock.

In the most practical benches the sides, bottom and posts are one continuous piece of concrete. Temporary posts, 2″x4″, are driven in the ground within 5″ of the height you wish the bench. These posts are in two rows, 4′ apart each way. On the tops of these posts are run 2″x4″ stringers, standing on edge. On these stringers are placed cross boards, 1″x6″, cut 6″ longer than the desired width of the bench. Every eighth and ninth board from the end has a half circle cut out so that when the edges of the boards are placed together a round hole, 5″ in diameter, will be formed. There should be two rows of these holes, the holes 4′ apart each way.

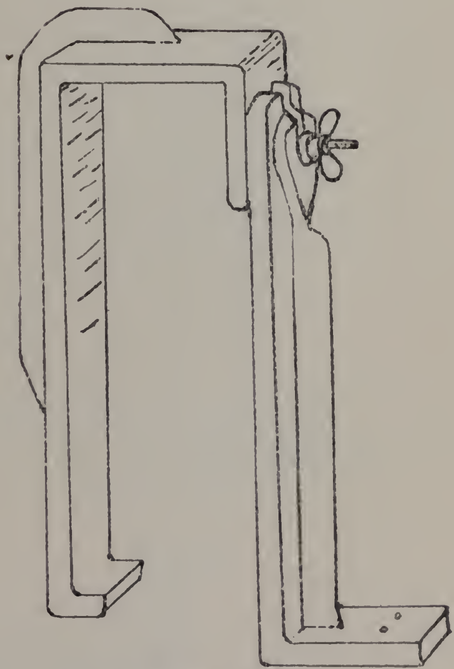
Under these holes the soil should be removed, digging holes about 8″ in diameter and 4″ deep, and filling them with wet concrete. Into this wet concrete the 5″ concrete posts should be imbedded, so that the top of each post comes flush with the cross boards, or flooring. It is easier to distribute these concrete posts and to embed them in the wet concrete as the flooring is being constructed.

The posts can be manufactured at odd times by the use of a leg mold (Fig. 1), 25 of these leg molds being sufficient to manufacture as many posts as may be needed.

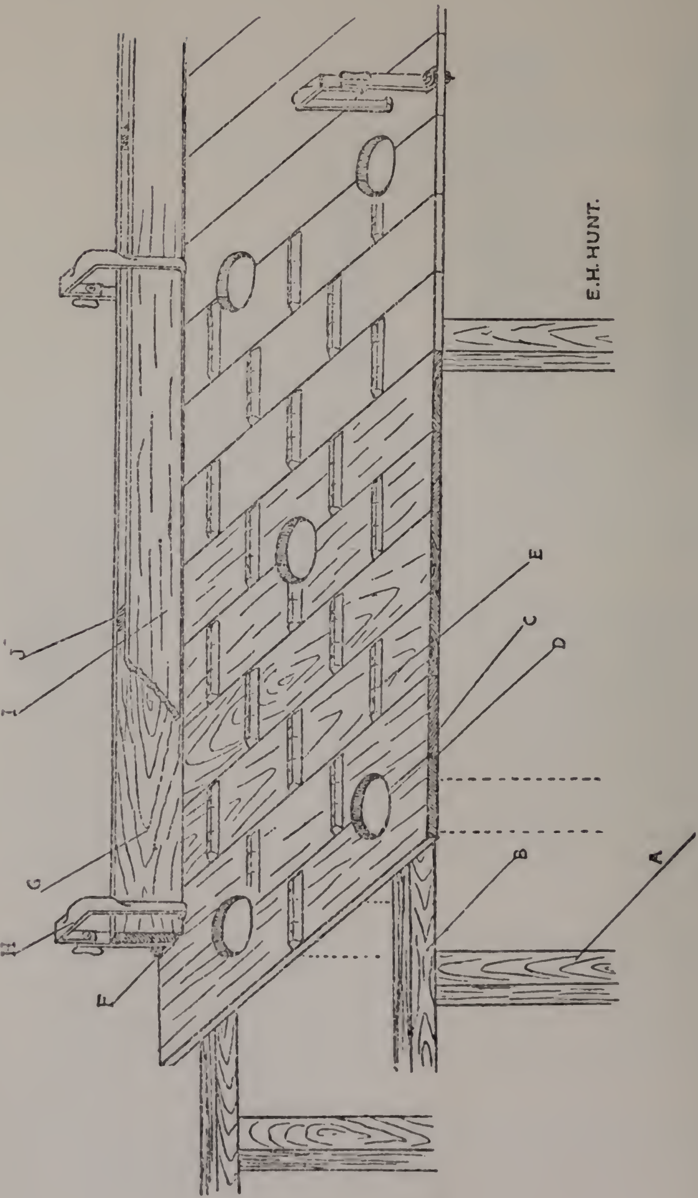
On the cross flooring of 6″ boards clamps (Fig. 2) should be nailed or screwed spaced 4′ apart on each side. Against these clamps a side board, 7″ wide, should stand on edge. It will be noted that the clamp (Fig. 2) comes in two pieces; the outer part should be screwed or nailed to the boards, or flooring.



Leg Molds
Fig. 1



Form Clamp
Fig. 2


A
B
C
D
E
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G
H
I
J
E.H. HUNT.

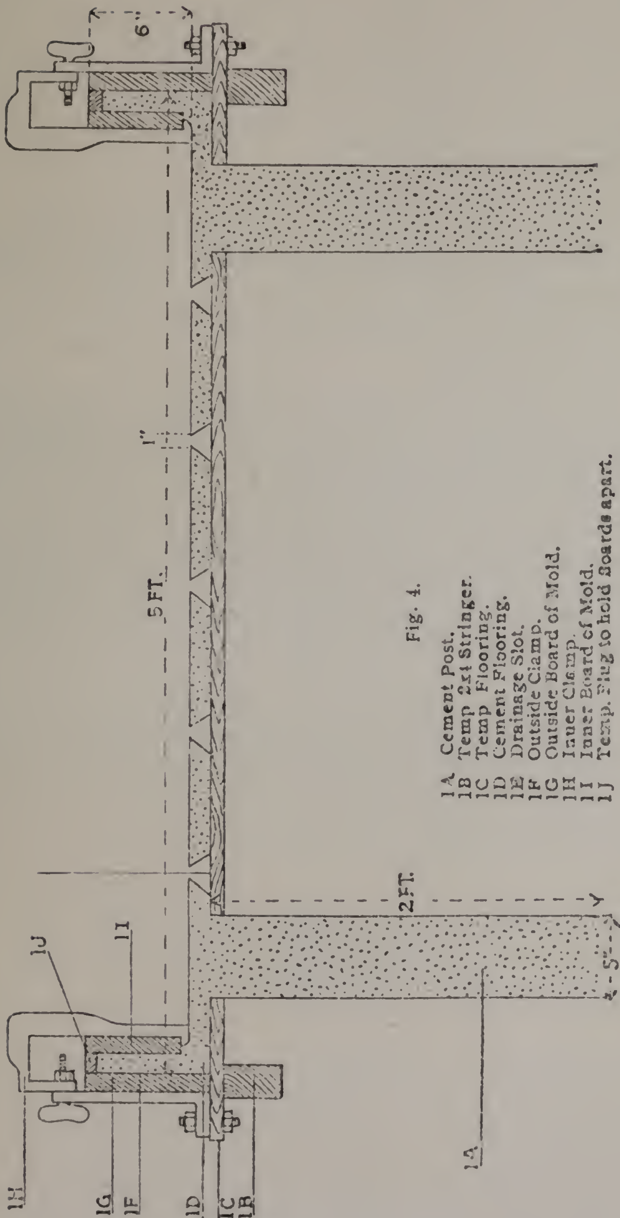

6"
5 FT.
1"
2 FT.
5"
1J
1I
1A
1H
1G
1F
1D
1C
1B
1A Cement Post.
1B Temp 2x4 Stringer.
1C Temp Flooring.
1D Cement Flooring.
1E Drainage Slot.
1F Outside Clamp.
1G Outside Board of Mold.
1H Inner Clamp.
1I Inner Board of Mold.
1J Temp. Plug to hold Boards apart.

Fig. 4.

REINFORCING THE SLAB.

When the outer boards are placed, wire netting should be run the entire length of the bench, and so turned up as to come flush with the tops of the side boards. After the wire netting is placed, another board, 6″ wide, should be placed in the inner part of the clamp (Fig. 2). After this is done the concrete should be poured. When the concrete is poured, this will give one inch of concrete on the sides and one inch on the bottom, and this wet concrete will thoroughly unite with the tops of the concrete posts already placed.

Fig 3 shows the use of drainage slots, which are shells of iron sheeting, 6″ long, 1″ wide at the top and 1½″ at the bottom, and contain two grooves into which the wire netting can be fitted. This method of drainage is preferred by some, while others prefer the round holes made after the concrete has partially hardened, by the use of the drainage tool. These holes can be spaced as near or far apart as the requirements of the soil or other conditions may indicate.

After the concrete is thoroughly hardened the 6″ inner board can be removed, the inner part of the clamp taken off, the temporary posts removed, and the stringers and flooring will then drop. The lumber may be used for the construction of other benches.

Fig. 3 illustrates the method of applying the clamps. Fig. 4 shows a cross-section of the bench. The completed bench is simply one continuous piece of concrete with 1″ side board and 1″ of concrete flooring, supported by 5″ posts. There are no other supports or obstructions except these posts. This bench can be constructed at a cost for material of 2¼c per square foot.

The clamp shown in Fig. 2 is a patented device, but the general directions given here for building forms for benches will prove valuable to anyone attempting this kind of work, no matter what clamp or other device is used for holding the forms in place.

HOW TO LAY WOOD FLOORS ON CONCRETE BASES.

There are at the present day in connection with building construction many conditions which call for a concrete floor with a wood finish, as it might be termed; that is, a wooden floor laid upon a concrete bed. There are several ways of constructing such a floor. Floors constructed as here shown are capable of carrying heavy loads with great economy of timber as regards the size of joist to be used.

In the methods described any of the usual joints may be adopted instead of rebated and filleted flooring, while if hardwood is the material the spacing of the joists must be altered to agree with the holes bored for the nails, for hardwood flooring is generally supplied ready bored for secret nailing, the holes being at regular intervals.

The following is a description of the floor illustrated in Figs. 1 and 2, the latter being a longitudinal section of the floor shown in the first illustration. Excavate over the area of the building as may be required; then level and prepare the surface and provide and lay hard broken brick rubbish 6″ thick, free from dirt, chips, shavings and organic matter, to be thoroughly rammed and left even and level on the surface. If a good hard bottom is found upon excavation the broken brick may be dispensed with. Upon this filling provide and lay Portland cement concrete, 4″ thick, composed of 1 part of cement to 5 parts of clean gravel, shingle or broken stone, ¾″ gauge, containing just sufficient sand to fill up the interstices, level and tamp until water is brought to the surface, which should be then floated.

The sleeper plates should be of fir, free from defects of every kind, 2″x3″, bedded evenly on the layer of concrete referred to above at intervals of 3′ 6″ center to center. The joists should be of fir 2½″x3½″, spaced 1′ 3″, center to center, and securely fixed to plates by two 2½″ wrought iron nails at each support.

The flooring should be in 4½″ widths, 1¼″ thick, laid with rebated and filleted joints with splayed headings. Fillets should be ⅜″x1″, and should be painted one coat before being laid. The flooring boards should be secured with cut flooring brads, two to each joist, weighing 20 lbs. per 1,000. The edges and rebates of the boards should have a thick coat of white lead paint applied when being laid and before being cramped up.

Provide and build in, in concrete, at intervals of about 6′, strong cast iron galvanized gratings 9″x3″, with a galvanized cast iron sleeve 9″x3″, built in behind the air grating through the wall cavity.

The floor shown in Fig. 3, of which Fig. 4 is a longitudinal section is, as regards preparation of ground, provision of hard, dry, brick filling, pro-

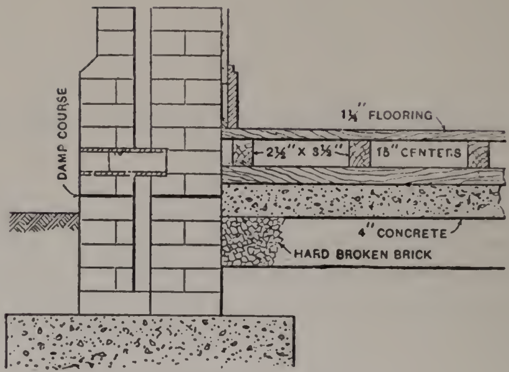


Fig. 1

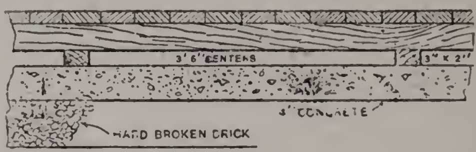


Fig 2

Fig. 3

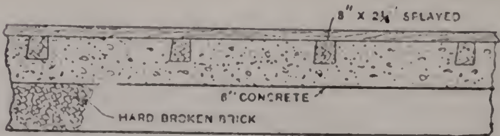


Fig. 4

portions, etc., of concrete, the same as the floor in Fig. 1, but the concrete is 6″ thick instead of 4″, and the sleeper joists are bedded *in* the concrete, being first creosoted to protect them from decay.

The sleeper joists should be of fir, free from all defects, and creosoted, 8 lbs. to the foot cube, 2¼″x3″, extreme scantling, splayed one edge, and securely and evenly bedded in the concrete 1′ 6″ center to center.

The "fat" portion of the mix is to be brought to the surface of the concrete, and all floated off level with the faces of the sleeper joists, and upon this floated surface the flooring is laid in a bituminous composition, composed of tar and pitch, in the proportions of 100 lbs. of pitch to 7½ gals. tar, boiled together for an hour or more, which will result in an elastic and tough composition when set. The dimensions of the sleeper joists are such as will admit of four being cut out of a 3″x9″ plank. The flooring is to be in 4½″ widths, laid with straight joints and splayed heading joints, secured to the sleeper joists with two brads to each joist, weighing 20 lbs. per 1,000, as in the other floor.

If preferred, instead of creosoted sleeper joists, concrete block 3″x3″, and, say, in lengths of 3′, may be bedded in the concrete in continuous lines at the same distance apart, the flooring brads being driven into the concrete block.

AN EASILY CONSTRUCTED MOLD FOR A CONCRETE MANTEL AND FIREPLACE.

Concrete has become our greatest building material of the present, lending itself to the greatest diversity of uses; so the molding of ornamental mantels from colored concrete is within the power of anyone, and this may be made an excellent financial aid by the concrete worker and contractor.

The mantel with fireplace complete as illustrated in Fig. 3 may be constructed from hearth to the top of chimney at a cost of about ten dollars and some slight labor. It has the advantage of adaptability to any building, old or new, with very slight alterations. When constructed with well-mixed mortar in two colors, using one as a filler in the panels and ornamental work, with the other for the body, it is a work of beauty, rivalling in this regard any art brick work.

The first section of outside mold as shown in Fig. 1 is constructed as follows: For the two panels at each side four boards of 4′ length and 18″ width are used; these should be of inch lumber, at the least. To form the hollows of the panels or inside, four strips 3½″ wide and 4′ long; two strips 5″ wide and 4′ long and eight strips 5″ wide and 12″ long, of inch lumber, are used. These are assembled as shown in Fig. 1 to form the panels which are 1″ in depth. After putting sides together, 1″ beveled strips are placed on the inside of the panels as illustrated, to mold same neatly. This prepares the two sides. For the front of outside mold, two panels are made as follows: two boards 12″ wide and 4′ long; four strips 2½″ wide and 4′ long; four strips 5″ wide and 7″ long and two strips 3″ wide and 7″ long. These are put together with the 2½″ strips on outside edge of boards 12″ wide, one of the 5″ strips at bottom and another 29″ higher from same, and the 3″ strip at top forming the double panel on each side of fireplace; the size of bottom panels being 7″x 29″ and the top panels 6″x 7″ each. Now, to form the panel above the fireplace and also to join the front sides together, one board 12″ wide and 36″ long is used, also two strips 3″ wide and 36″ long to each outside edge of the 12″ board. The board is placed with its ends joining the top edges of side panels, to which it is fastened with a cleat on each end or small iron straps. The insides of all above panels are lined on edges with the 1″ bevel molding. This forms the front of the first section, which is fastened to the two sides previously explained by nailing the sides to the front to form a box with three sides, as illustrated in Fig. 1. Sides lap over the front sufficiently so that they may be securely fastened; the construction may be further strengthened by corners, made from strap iron.

To the top of this section the form to mold the ornamental shelf is fastened, the lumber of which is cut as follows: One board 6″ wide and

5′ 8″ long, which is nailed to the front of this section, projecting out; two boards 6″ wide and 34″ long, which are nailed to top of sides. To these are fastened as shown in Fig. 1 two boards at the sides, 6″ wide and 38″ long and one board 6″ wide and 5′ 8″ long at the front, projecting up as shown in illustration. As these boards so fit together as to brace the entire section, extra bracing will not be required. To form the ornamental molding on shelf the above projecting form is lined with ½ hollow molding or Cavetto molding so as to form the half-rounded ornamentation to shelf and is placed in position as shown in Fig. 1. It is necessary in the outside

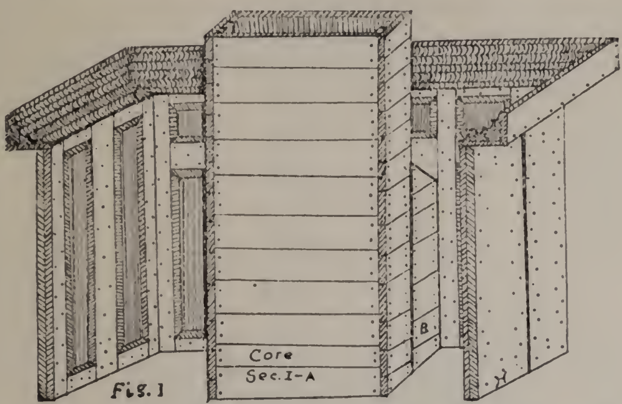


Fig. 1

forms to have the joints well fitted so as to give a smooth effect to the molded work.

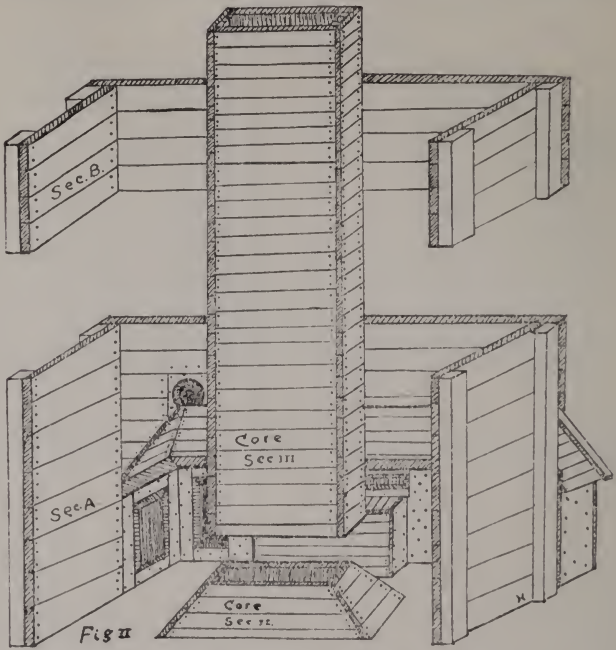
HOW THE CORES ARE FORMED.

In making Sec. 1-A of core, four strips 2″x 2″ and 4′ long are used; these are used as the upright posts, as shown in Fig. 1, and are boarded up on the sides with boards 34″ long and on the ends with boards 16″ long, the end boards lapping over ends of side-boards as illustrated. The side of this section is not boarded down complete on the side that goes to the front, as Sec. 1-B sets up against same. Sec. 1-B is made as follows: Two strips 2″x 2″ and 36″ long and two strips 39″ long of the same sized lumber are used for the uprights and are boarded up on the two ends with boards 14″ long and on top with boards 34″ in length; the two sides require only strips to hold them in place, as the 39″ side sets up against core Sec. A and the 36″ side sets out through the front of first section of mold and forms the opening in the fireplace. • These two sections of core are held together with small hooks when in use; the hooks are placed on the inside of the core sections and are unhooked when removing from the finished work. It may be taken out easily when in the two sections as illustrated. This completes the first section of mold, and as you will note allows the casting either of a 5″ firewall at back, by setting the core so the front projects one inch through opening in the front section, or a 4″ fire wall with the core flush with edge of front section.

For the sides of Sec. A in Fig. 2, four 2″x 2″ strips 3′ 4″ long are used; these are boarded up as shown in illustration with boards 25″ long. The two sides are joined together at the top by a plain board 4″ wide and

5′ 4″ long and below this is placed a plank 5′ 4″ long, 8″ wide and 2″ thick, at the bottom edge of same; on the inside, two circles are made with the centers exactly 17″ from each end; these are hollowed out with chisel to the depth of 1½″ and form the circle ornaments above top of mantel shelf.

To make the paneled part of this section, two boards, 8″ wide and 15″ long are used for the sides; these are paneled by cutting four strips 2″ wide and 15″ long and four strips 2″ wide and 4″ long. These are placed on



the edges of the 8″x 15″ boards to form a panel in center, 4″x 11″, which is lined with the one-inch bevel molding. These two sides are joined together with the three front panels.

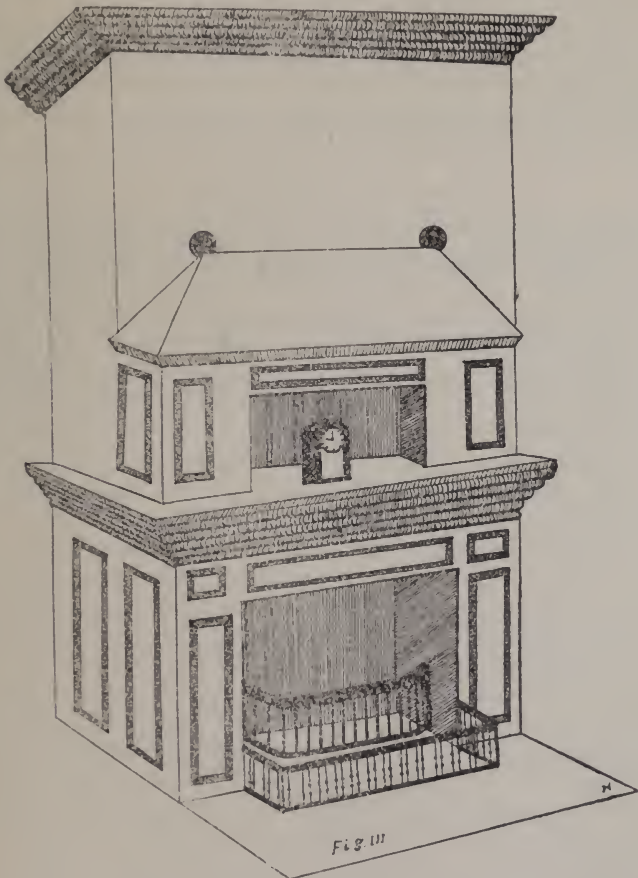
For the two panels at each side of the opening above mantel shelf, two boards 17″ wide and 15″ in length are used; these are paneled by placing two strips 4″ wide and 15″ long on the sides that are used next to opening and two strips 5″ wide and 15″ long on the opposite edges; at top and bottom, four strips 2″ wide and 8″ long are placed, forming a panel that is 8″x 11″ for the two panels at front of this section. For the panel above opening in this section, use a board, 6″ wide and 30″ long, and panel it by placing on the two side edges, strips 1½″ wide and 30″ long, to form a panel 3″x 30″. Join this to the two side panels with edges abutting and fasten with cleats or iron straps. Then join to the two side panels, with the edges of the front overlapping the sides. For the opening above mantel shelf make a box 6″ wide, 10″ high and 30″ long, closed at ends and two sides; fasten this in position as shown in Fig. 2, between the two front panels, which will brace the form.

For the projecting edge at top of this section, cut two 3″ strips 11″

long, and one 3″ strip 5′ 6″ long; miter corners and nail to the top of paneled section, projecting out.

COMPLETING THE FORMS.

To form the roof of this section, cut two strips, 2″ wide and 18½″ long, and two strips 2″ wide and 21½″ long; miter to a point, placing one of each length together, with a width at bottom of 11″, and board up on the inside; place these on top of paneled section with the bottom at edge of the 3″ projection and the top or point of the triangle 14″ from the end



of the entire section; this requires a board 3′ long to reach between the points of triangular sides, to boards 5′ 6″ long for the bottom. This section is boarded up on the inside with joints closely made so as to mold the roof smooth and even.

The section is now joined to the plain section and the spaces from bottom of roof to the top boarded up as shown in Fig. 2. This completes this part of second section.

For Sec. 2 of core, cut four strips 2″x 2″ and 14¼″ long, board up with boards 16″ long at bottom, drawing in to 8″ at top; for the sides, use

boards 32″ in length for the bottom to 18″ in length for the top, fitted together with ends overlapping sides as shown in Fig. 2. This forms this section of core with dimensions of 16″x 34″ at bottom and 8″x 20″ at top, outside measurements.

For Sec. 3 of core, use four 2″x 2″ strips, 4′ long; for the sides, board up with boards 18″ long and for ends use boards 8″ long, ends overlapping sides as shown in Fig. 2. This section of core may be made any length desired for convenience in handling. If made in one and two-foot sections it may be removed from the finished work with greater ease. This size is used to the top of chimney or to the opening entering same where a brick chimney is used.

For section B in Fig. 2, four strips 2″x 2″, one foot in length are used, boarded up on ends with boards 25″ long and on the front side with boards 5′ 4″ in length, joined as shown in Fig. 2. Enough of these sections must be provided to reach to the ceiling of room; in ordinary rooms the described sections will do this, as we have an elevation of 8′ 9″.

TO SET UP THE MANTEL.

In operating, after the hearth is laid the size desired, the sections illustrated in Fig. 1 are placed in position with the open side of outside section against the wall of room, sections A and B of core are placed, with B fitting into the fireplace opening in outside section, which will place Sec. A within 5″ of the wall of room. The forms are now filled with concrete mixture and where panels are desired of a color different from the main body of work, fill them with mortar of the desired color, using a plastering trowel. When this form is filled and the top leveled, allow the mortar to set sufficiently so that you can remove core. This is done by unhooking the two sections and drawing Sec. A up through the top; this will allow Sec. B to be taken out easily.

Sec. 2 of core is set over this opening, where Sec. 1-A of core is removed, and is braced at bottom to hold in place by setting 2″x 4″ strips under same. Sec. A, Fig. 2, is then placed in position and filled with the concrete mixture until core Sec. 2 is required and used, as well as Sec. B.

Where a molding is to be used at ceiling, it will be necessary to set into the concrete when filling Sec. B, a wood strip to nail the molding to. Where it is desired to mold this in concrete, the same form as used on first section may be used or built on Sec. B with measurements altered to fit.

In removing Sec. 2 of core, it may easily be taken from the fireplace opening and when removed will allow Sec. 3 of core to be raised up by placing braces under same until the work is completed. Then it may be removed from the top.

This method of working allows the outside sections of the forms to remain in position until the concrete has become firm enough to remove them with perfect safety, so there is no danger of chipping whatever and the whole work can be completed at one time, as what little damage is done to the inside by removing and changing cores, while the mortar is still "green," can be easily repaired with the trowel.

These simple forms may be easily constructed by the average concrete worker, or may be altered to suit desires and conditions of the building in which it is placed. These fireplaces offer an attractive line of work and good returns for the contractor.

AN ADJUSTABLE MOLD FOR SILOS, STANDPIPES, WATER TOWERS, ETC.

In the erection of silos and all other circular structures built of concrete, there has always been the bother and expense of a mass of lumber from which to build the forms; much of this is necessarily wasted when the work is not of uniform dimensions. The adjustable mold illustrated in this article should therefore be of interest to all concrete workers constructing this class of work.

As illustrated in Fig. 1, both forms, outside and core, are built in 12″ sections or segments of a circle. These are joined together with bolts, making it possible to enlarge the size of form simply by adding an additional section to the forms.

In the same manner, it may be reduced to any desired size. Any size of wall can be molded, by the simple and easy method of adding the adjustable sections from the outside and core forms, or removing them.

In Fig. 1, the 12″ sections are shown partly completed and assembled. To illustrate the construction we will assume a circular form with an outside diameter of 8′; walls 8″ thick, giving the inside space a diameter of 6′ 8″; this will require twenty-four 12″ sections and one 10″ section for the outside form; for the core form, there will be required twenty 12″ sections and one 8″ section.

In constructing sections, it must be noted that upon one-half of the segments the side pieces are just 12″ long and upon the others two inches longer on each side, so that they will project over to be bolted to the others.

For the side pieces cut 2″x4″ strips into lengths of 12″ and the same number 16″ long. On the 12″ strips, mark and cut from one side an oval 12″ long and 1¼″ in depth; this can be done by marking the depth of oval. 1¼″ in the center, on one side, then drawing the oval to each extreme edge. Now cut strips, one inch square and 4′ long; nail these to the inside of this oval, the top edge of strips even with the side piece on top and to project two inches beyond the edge of the lower side piece; this completes one of No. 1 sections, as illustrated in Fig. 1, when the holes are bored in side pieces for bolting together.

For the No. 2 sections illustrated, use the 2″x4″ strips that are 16″ long, on one side. Exactly 2″ from each end, cut into it exactly ¾″; now in center of this side make the depth of oval just 2″ in from edge. Draw the oval line to the ¾″ cuts. This makes the same degree of circle, but is set into the side piece ¾″, an advantage when joining to the No. 1 sections.

These side pieces are covered on the oval sides with 1″ square strips 4′

long. At the bottom these strips are nailed even with the edge of the side piece and exactly 2″ from the top, so that they will join with the No. 1 sections and have the sections exactly even. Holes for bolts are bored so that when the outside sections are set together with their edges even the bolt holes are in line for bolting them together.

Pieces cut from the ovals on outside sections can be used as patterns in making the core sections. The length of side pieces is the same as for the outside sections, with the oval segment to project out instead of in the 2″x4″ strip.

Core sections are covered on the oval side with strips 1″ square and 4′ long, as with the outside sections, and as illustrated in Fig. 1. These must be nailed to the side pieces so that when bolted together the top edges of strips or sections will be even.

For both the outside and the inside or core sections, it will be necessary to build a few sections of odd size, 6″, 8″ and 10″ in width, made of the same materials as the regular sections and with the same degree of oval; these are used to make the circumference of the desired size when a certain circle is desired. Two of each of these sizes, one of No. 1 and No. 2 for both outside form and core form, are all that will ordinarily be required.

ASSEMBLING THE FORMS.

The sections are assembled and bolted together, as shown in Fig. 1. While the circle is perfect for an 8′ outside diameter, for a larger or a smaller size it will not be absolutely so, but very close to it. In fact it will be as perfect as can be made with the usual board forms built for this purpose. The only possible divergence will be at the joints of the sections and this will be very slight, in fact so slight as to be unnoticed in a circle of this size, and for all practical purposes it will be entirely satisfactory.

The insides of sections should be covered with one or two good coats of shellac so as to fill all joints of the sections and make a smooth molding surface.

For the supporting platform illustrated in Fig. 2, cut four 2″x8″ strips 12′ long (this length varies with the size of work to be constructed). Bolt them together, as illustrated, so the outside form will rest upon the platform and yet be entirely clear from the work. The side pieces of sections are bolted to this supporting platform where they meet; this will hold the circle in the proper position.

At the four corners of the supporting platform, four pulleys are fastened for raising and lowering, as illustrated in Fig. 2.

The core sections are now placed inside the outside forms and two 2″x4″ strips, long enough to reach across the outside form, are bolted to the core sections and also to the outside form so as to hold the core exactly in position.

Braces can be nailed from these 2″x4″ strips down to the bottom of core sections, on the inside, so as to hold the forms rigidly in position and help bear the strain when raising the forms from completed work.

The four uprights are set in position so that they will guide the raising of the mold and platform in a straight line. The proper direction may

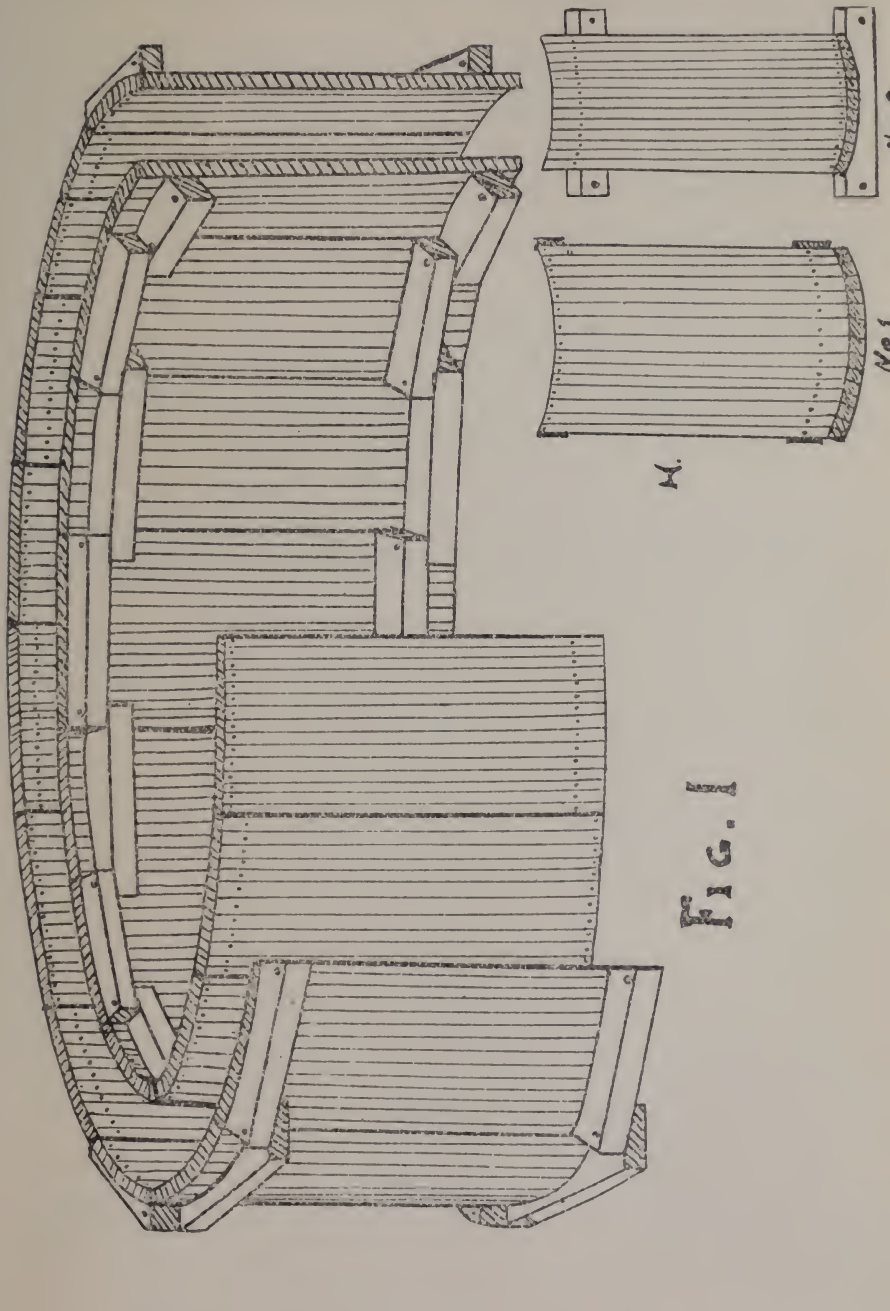


FIG. 1

be further assured by having a second platform at the top edge of molds if desired; this would make it certain that the walls would be kept plumb, but would be somewhat in the way when tamping the concrete. Without this, the wall may be kept in plumb by an instant's use of the level whenever forms are raised.

Uprights are fastened together and braced as illustrated in Fig. 2 or in such manner as the requirements dictate. The pulleys are arranged at the top beams of the uprights and these serve to raise and lower the form and platform quickly and easily with the rope or wire cable used in pulleys.

The platform that serves as a support to the forms or molds is also used as a scaffold or staging for the workmen who fill the molds, by the addition of an extra plank on each side.

To this upright framework, a lift or elevator for delivering the concrete may be attached, thus saving time and labor. In large work, where the forms could not well be raised by two men, a small capstan may be employed for this purpose. With both ropes or cables attached, this will insure that the forms are raised evenly. The locking device on the capstan will also make sure that the forms will not drop when operating.

THE WORK OF CONSTRUCTION.

The operation of construction is very simply explained. As fast as the form is filled and the concrete tamped, it is raised so that the bottom edge of the form is from four to six inches below the top of the completed wall. This aids in raising the forms evenly and keeps the wall plumb.

If any difficulty is experienced in raising the form, the operation can be made easier by having the outside sections at each of the four corners of supporting platform so they may be easily unbolted and thus swung out free from the concrete, making it easier to raise the forms.

For the openings in the wall, forms of the desired size can be made, and when the wall is molded these forms can be set in the proper position, lightly nailed to the molds so as not to be displaced by the tamping of the congrete. The nails are, of course, to be removed before the forms are raised.

This allows the openings to be molded with the wall of any size or shape desired, without delay in the construction.

The forms also permit any reinforcement to be used with ease. A guide-mark can be made on the sides of molds where the reinforcing rods are to be placed at a certain distance apart. This insures that each rod will be placed in the correct position, and as they are embedded in the concrete as the wall is molded it is impossible for them to become disarranged as with the usual methods.

Where is is desired to decrease the width of wall as it is built, this can easily be done by raising the form clear of the completed work and adding another section to the core. This section may be a 6″ or 8″ section first, then changed to a larger one, so as gradually to decrease the width of wall as it rises.

As the forms are never more than 4′ above the concrete, the workmen are able to tamp the wall very thoroughy, thus securing better results than

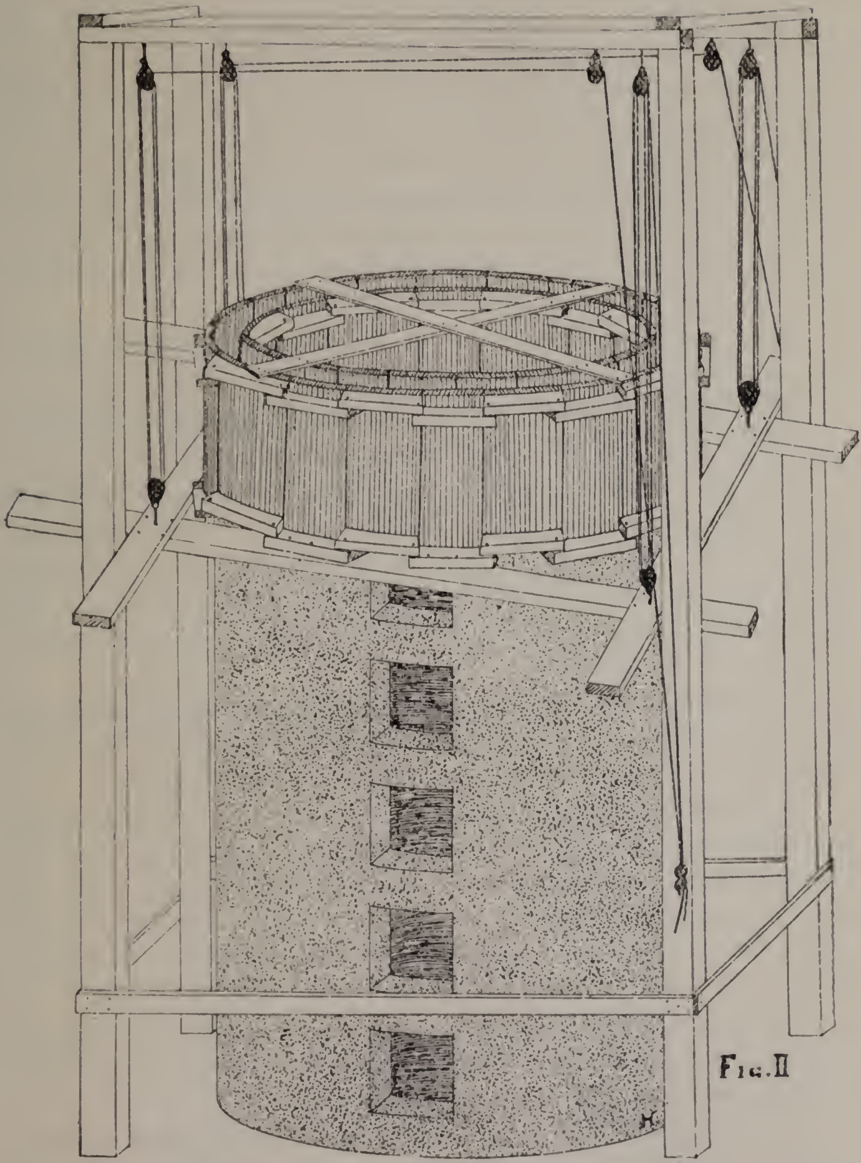


FIG. II

when the entire silo form is erected and the mortar simply poured into it with little or no tamping, except in the top course.

ERECTING A STANDPIPE.

The construction of a standpipe with these forms is in every way similar to that of a silo, without the openings. The foundation or anchor rods for a ladder or stairway to reach the top, are easily made by embedding large bolts in the concrete wall at the proper distance apart. These are used with the nut end even with the edge of outside form. Two nuts or one nut and several large washers are screwed to the bolt and these mold in the concrete wall a space for the ladder or stair supports. As the bolts are held firmly in the wall, in construction the nuts are unscrewed and the stair supports are fitted onto bolts and tightened down.

The water tower illustrated in Fig. 3 may be built from foundation to roof of reinforced concrete with these molds.

For illustration, we will make the diameter 8′ outside, the supports or uprights 12″x20″ and 15′ high to bottom of the tank.

With the outside mold adjusted at an 8′ diameter and the core at 6′ we have the proper proportions. For the uprights use eight boards 12″ wide and 15′ long; set these upright in the molds between the two forms, each two boards 20″ apart and at equal distances around the circle. This will require the upright forms to be placed 52″ apart in the circle, measuring along the outside form.

These uprights are to be braced so they will stand up plumb and yet so the braces will not interfere with the raising of the mold. This can be arranged by placing the cleats at top and braces between them.

The supports are molded in this way, the same as a solid wall, adding any reinforcement desired as the work progresses, until the top of the supports is reached. The inside or core mold is then taken out and a floor built for molding the concrete floor of tank. This is braced from the ground to hold up mortar so as to allow the floor of tank to bond with the supports, the bond being increased by heavy reinforcing at this point.

After the floor of the tank is laid, the core of mold can be replaced, adjusted to the desired size. The tank walls and the tank are molded in the same manner as a silo.

In this method of construction a better bond and more secure reinforcement can be secured than when the uprights are built of block and the tank added later.

The 12″x20″ size in uprights is merely used for illustration and not as a guide to size, which must be determined by the height of the structure and the size of the tank.

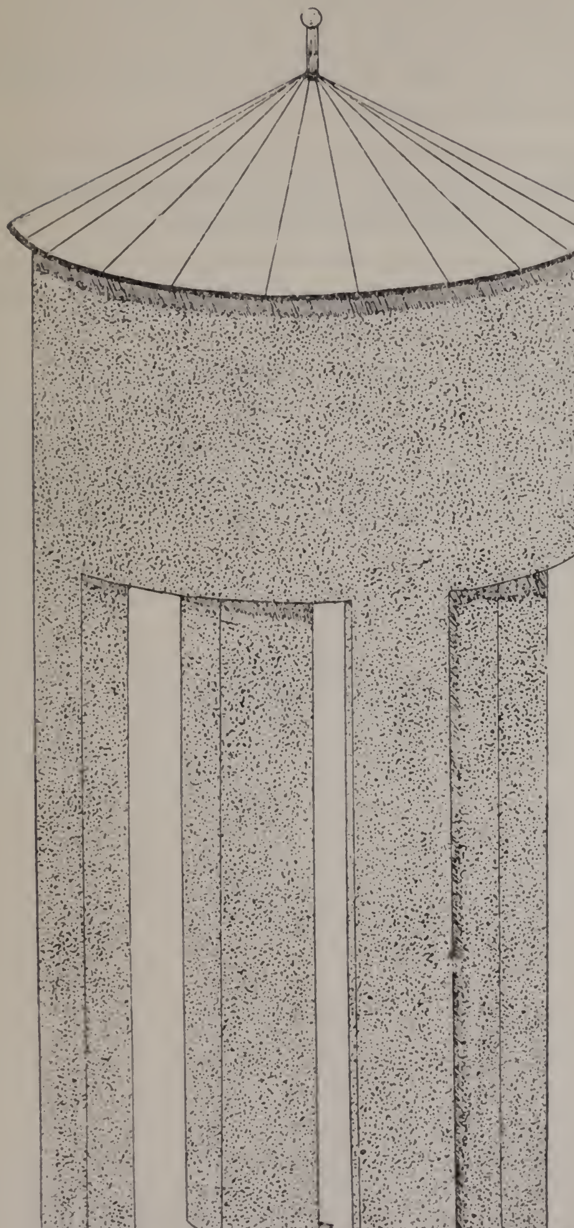


FIG. III

A much more artistic effect can be made in this class of work by bending the two upright boards together at top to form an arch. This will cause the supports of the tank to take the form of a series of arches and makes a very pretty effect from the architectural standpoint, besides strengthening the wall or supports.

For a number of other uses these molds will be of service to the concrete worker, as they may be quickly and easily adjusted to the size desired and assure molding the wall of a uniform thickness.

Another advantage is the ease of moving the outfit from one job to another, without the usual large expense in making the form molds and no waste of lumber in erecting or tearing down.

The entire expense of building is moderate and should be amply repaid with the first job. In all localities there is a demand for good concrete work of this kind. It is easy to do the work, as with this method of construction the work can be nearly completed in the time formerly wasted in building the forms. This enables you to meet competition successfully.

REINFORCED CONCRETE TANKS BEST FOR FEED-WATER STORAGE.

Whenever a power plant uses city water, or, in fact, any source of feed-water other than the direct suction of its own feed pumps from some natural supply on the ground, this feed-water supply at once becomes the most vulnerable point in the power system. Stoppage of this supply ties up everything else.

It is, therefore, absolutely essential to provide three or four hours' storage capacity for boiler-feed water. This must be done cheaply, and it is important not to use up any valuable building space, nor to get too far from the power plant.

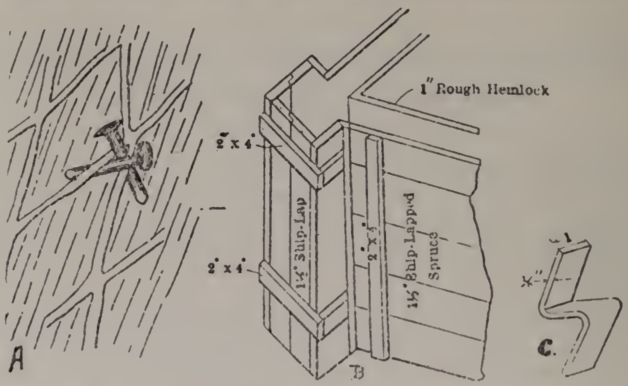
A cylindrical iron tank possesses a number of disadvantages. It holds little water for the land it occupies; it is expensive to buy and have delivered on the ground, besides requiring to be assembled on the foundation; it carries a depreciation of about 10 per cent per annum and must be cut up for junk in fifteen years; it requires massive underpinning, unless the corner of some brick firewall is handy to the power plant, and heavy foundations if set on the ground. The cypress-stave tank is better, but has the same objections as to depreciation, area of floor space, etc.

On the whole, the rectangular reinforced concrete tank offers the best proposition. It is easy to find ground space for it, in some angle around the power-house chimney, for example. It suffers no depreciation and requires no repairs. It costs little more than the foundations for an iron or wood tank. And, at about the time you are thinking of replacing the latter because of old age, the concrete tank will still be gradually approaching its maximum strength.

The most economical manner of building the tank is to put most of it under ground, and leave not more than 6 or 8 feet above ground to resist water stresses. These mount up surprisingly with the height. At 6 feet, the point of maximum pressure will be 432 pounds per square foot at ground level. It is entirely permissible to neglect the water pressure below ground. Even in poor soil the resisting capacity of the earth surrounding the tank walls below ground can be taken at two tons per square foot, precisely as in foundations.

A pit is first dug, with plumb sides equal to the outside dimensions of the tank, and a footing or floor of concrete about 9″ thick, laid down. Next, a box form of the inside dimensions of the tank is set up, and the space between it and the pit walls filled with concrete up to 2 feet below ground level. The reinforcing rods for the above-ground section can now be set in place, and the work poured to ground level, securing the rods in position.

The first real carpenter work will be to set up the outside forms, Fig. 1, and nail the expanded metal to them, N-shaped separators of 1″x1/8″ flat strap steel being used to hold them away from the surface of the forms. Another scheme is to drive two nails crossing at the intersection of the diamond meshes of the expanded metal. A single nail driven at the proper slant will also serve to hold the reinforcement about an inch off the forms,



but is weak and likely to come out in the ramming and placing of the concrete. It is mentioned here because carpenters are too liable to discover this method themselves and to work it with enthusiasm as being the easiest possible method.

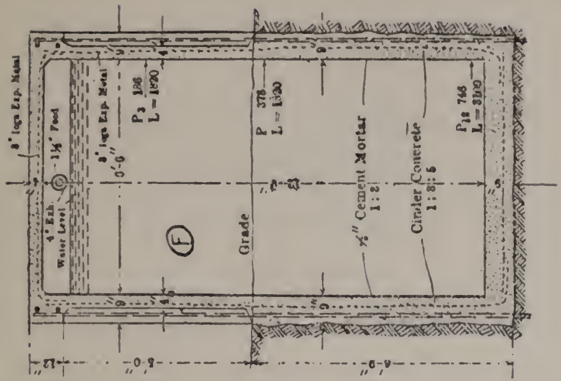
A dense, impervious cinder concrete should be used. The 1:2:4 mixture gave very good results in the tank illustrated. It will have no bad spots in it, nor will it leak or sweat.

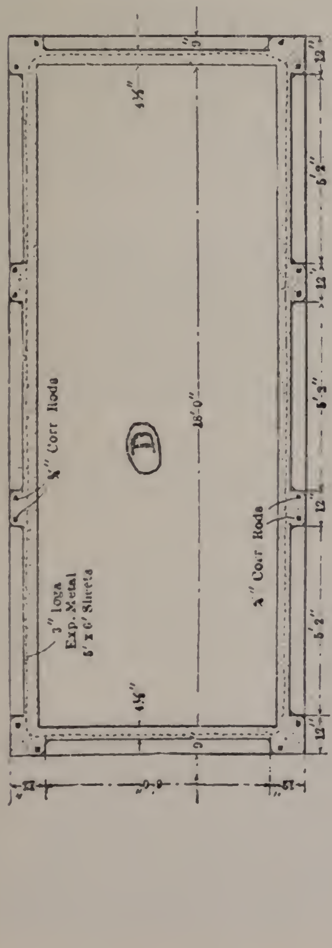
The ceiling is poured with the same cinder concrete mixture. Four inches is plenty deep enough, using expanded metal along to reinforce the slab. The walls and bottom of the tank should be plastered all over 3/8″ deep with 1:3 cement mortar. Do not allow any lime in it, as lime-cement mortar soon becomes pervious under water pressure.

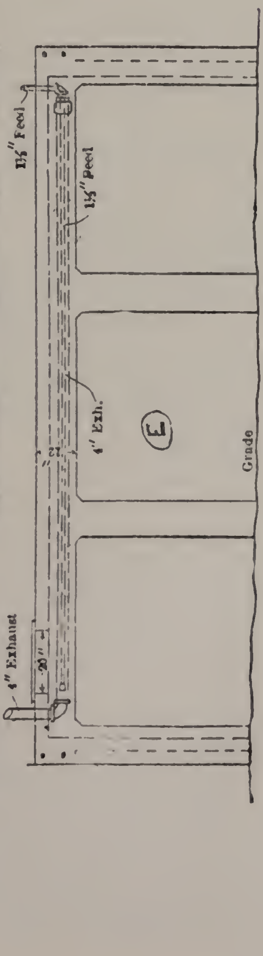
It often occurs that there is exhaust steam, not otherwise condensable, which may be led into the feed-water tank. If a T is left on the main exhaust pipe, and a suitable pipe led off to the tanks, much of this steam will be condensed and give a preliminary heating to the feed water. This pipe should run the length of the tank just above the water.

THE COST.

The actual cost of the feed-water storage tank described was \$482.26; the iron tank which it replaced cost \$648.68, including \$120.56 for a foundation of 10″ I-beams cut into brick walls across a 14′ alley between two buildings. This is the cheapest possible foundation. Supposing that the iron tank were to be placed on concrete piers on the site of the present tank, the tank being 12′x12′, five piers would be required, besides the footing. With the top of the piers 2′ above grade and the bottom of the footings 4′ below, the estimated cost of this foundation would be about \$140. As the tank itself cost about \$528.12, set up, to replace the concrete storage tank with a steel one on the same site would cost \$668.12. The cubic contents are identical.


F
Grade
Water Level
4" Exh.
1¼" Feed
½" Cement Mortar
1 : 2
Cinder Concrete
1 : 3 : 5
P 378
L = 1320


D
18'-0"
½" Corr Rods
½" Corr Rods
3" 10ga
Exp. Metal
5' x 6' Sheets
5'2"
12"


E
Grade
1½" Feed
1½" Feed
4" Exh.
4" Exhaust
20"

PLANS FOR A MODEL CONCRETE TILE MANUFACTURING PLANT.

We have had many requests for information concerning the establishment of plants for the manufacture of concrete tile, especially drain tile. Firms who now operate concrete products plants and individuals who wish to engage in the tile business as an exclusive line, are interested in suggestions for the layout of the plant, arrangement of machinery, material bins, etc.

We present here a model set of specifications covering the principal points to be taken care of in erecting and equipping a tile plant. We are able to print these specifications and the accompanying plans through the courtesy of the Miracle Pressed Stone Co. This company drew up the specifications and designed the plant with the idea of helping tile manufacturers to operate better plants. Like all other branches of the concrete industry, the tile business is most successful when it is placed upon a firm, modern basis. A modern plant, equipped with modern machinery, will make money for its owners.

The plant here described presents many economical features. The steam-curing process is undoubtedly the best for drain tile and the use of transfer cars is of course necessary, and desirable, where the tile must be carried from machine to curing room and from curing room to storage yard. The specifications which follow are quite complete and may be followed safely by any company employing a contractor to build its plant.

General Conditions:

It is the intention that the drawing and specifications shall co-operate so that work shown in one and omitted in the other, or vice versa, shall be executed the same as though set forth in both.

Excavating and Grading:

Contractor to do all necessary excavating of trenches for walls, post footings, etc., as required by plans and specifications. Also level off the surface of ground where the building is to stand, taking off all sod and making the surface perfectly straight and level.

Foundation:

Build concrete foundation walls under all outside walls and under kiln walls 1′ 6″ thick and 3′ high from bottom of wall to grade level. Also put down good piers 2′x2′x3′ high under all columns and posts. Also walls 1′ 6″ wide and 1′ 6″ high under wood partitions. Foundations to be made of good concrete composed of clean sharp sand, coarse gravel or small broken stone, and good Portland cement, of American manufacture, mixed in the proportions 1:3:6. Make the wall piers straight and true and level on top.

Walls of Superstructure:

Construct the walls of superstructure of good hard hollow concrete block, made 1:4 of good Portland cement mortar, clean sharp sand; size of block, 9″ wide on bed, 8″ high and 24″ long, block to be smooth, rock or panel face. Block to be laid in good Portland cement mortar, all joints neatly pointed.

The end walls to be carried above roof as shown and cemented over the top. Set concrete sills and reinforced lintels to all windows and outside doors. Build the kiln division walls as shown by plan from top of footing of cement concrete, 6′ 6″ high to underside of concrete ceiling. Concrete made as heretofore specified, 1:3:6. Crib the sides of walls in usual manner and fill in the concrete, tamp down hard.

Concrete Floor:

Level off the bottom, making the surface straight and true, and cover the bottom with 3″ thickness of concrete same as used in foundation walls, the concrete to be used as fast as mixed, and rammed down hard. Finish the top with a good 1″ coat of Portland cement and sand mortar, 1:2, troweled straight and smooth on top.

Reinforced Concrete Work:

All concrete lintels to be made the full width of wall and reinforced in sufficient manner with ½″ rods.

Overhead beams across the front and the columns carrying same to be of reinforced concrete.

The columns to be 18″ square, with 15″ core area, made with six 1″ rods and wrapped with ⅜″ spiral rods 3″ apart. Girders to be 18″ deep by 12″ wide, made with five 1¼″ rods lapped 2′ over columns. Stirrups ⅜″ rods, 5″ centers at ends, and 9″ centers at centers.

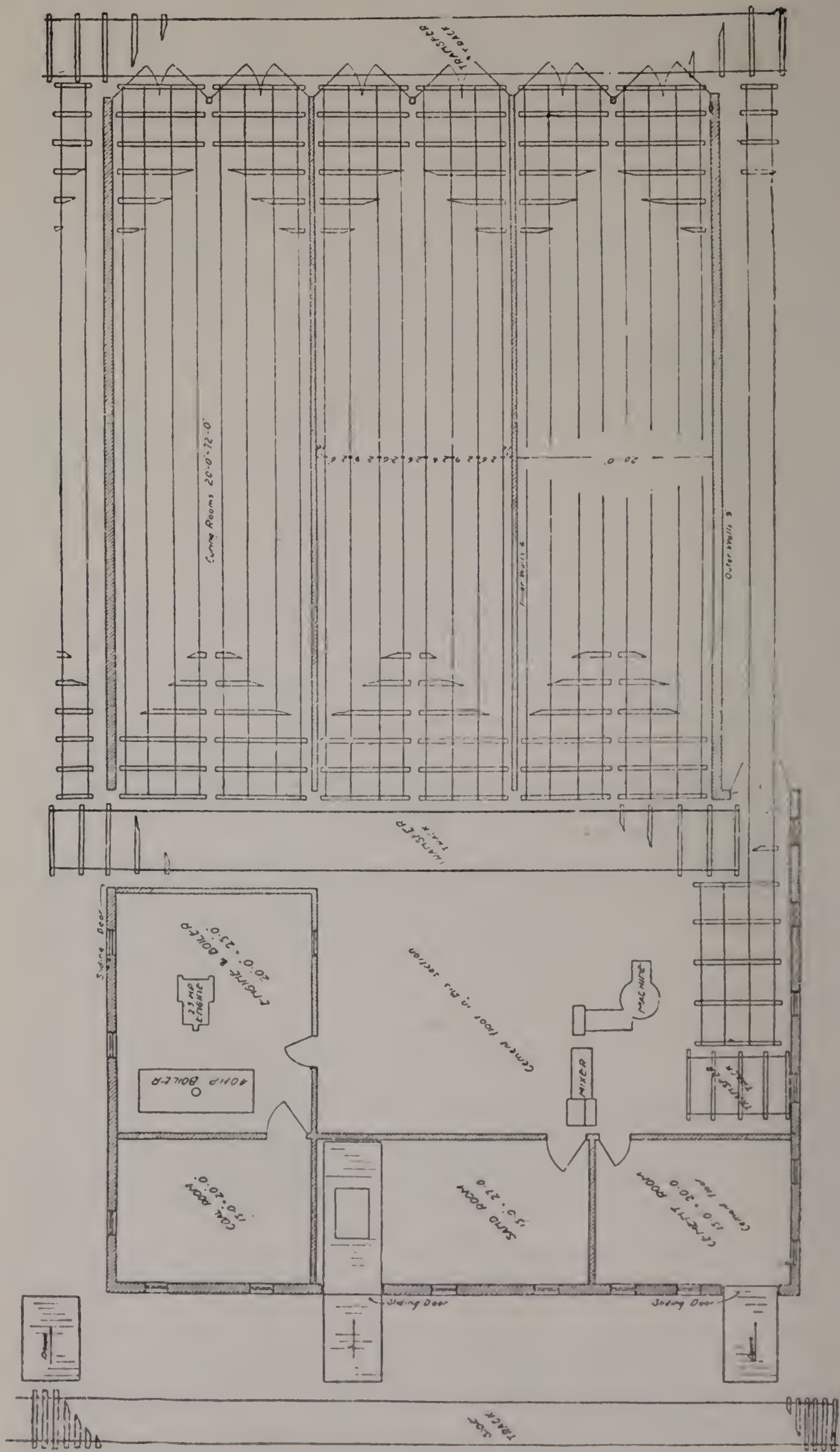
All planking for columns, girders and ceiling to be done in a substantial manner. *Alternate:* In place of reinforced concrete ceiling use 2″x6′ ceiling joists, 2′ on centers, supported through centers with 1″x4″ strips nailed to roof rafters. Board over the top and tin over the ceiling with good I. C. charcoal tin.

Timber and Framing:

All timber in the construction to be of good sound Norway pine, hemlock or fir, free from large or loose knots or shakes. The main posts through the building that support the roof to be 14″x14″ with cast iron plates with socket over end of post, and 6″x12″x12′ oak corbels on top. Set tension rod girders across the building, supported on the columns; these girders to be constructed of two 4″x12″ seasoned timbers bolted together with ⅝″ bolts and a 1¼″ wrought iron tension rod between.

Construct the roof according to plans, with 2″x8″ rafters placed 18″ on centers, and lap together over the girders and spike together solid.

Set all partitions as shown by plans with 2″x6″ studs, set 16″ on centers, with double sills and plates, the partitions to stand on concrete footings and carry up to underside of roof, except the partition on one side of sand room that is to be 4′ high. Board all partitions on both sides with matched and surfaced fencing, put on diagonal and reversing the courses on



each side to make rigid walls. Set 2″x4″ stud partition around the upper raised portion over boiler room, etc., and board the same with shiplap siding, well nailed.

Roof:

The roof rafters to project over with a fascia board. Board all roofs with No. 3 boards, put on with close joints and well nailed to rafters. Cover the roof boards with approved roofing. Make a good piece of work of the roof.

Windows:

All common windows 2′ 6″ x 5′ 0″ made with plank frames and two sash, glazed with best double thick sheet glass. All windows in the upper boarded walls around boiler room, etc., are to be made with plank frames and a portion of the sash hung at top with wrought iron butts to swing inward, and secured with bolts.

Doors:

All large outside doors to be batten doors, made of good seasoned surfaced and matched pine flooring, put together perpendicularly on the outside and diagonal on the back side, made good and substantial with wide cleats. The sliding doors to be hung with steel tracks and rollers and secured with heavy hasps and padlocks. The large doors that swing outward to be hung to plank frames with heavy T-hinges and secured same as others. All single doors to be four-panel pine doors 1⅓″ thick, hung with good steel butts and have heavy door handles and mortise locks.

Painting:

All outside woodwork to be painted two good coats of white lead and linseed oil paint.

Transfer Cars:

The contractor shall furnish four transfer cars, with cross-tracks placed as shown on ground plan.

Tracks:

The contractor shall furnish and lay all tracks and track material according to plans; rails to be 30-lb. or 35-lb. steel rails, to be laid of a suitable gauge to fit cars; he shall furnish two thousand feet of track and materials complete for the building and yards. Ties to be of cedar not less than 4″x6″ and 1′ longer than the gauge of the track, and spaced not more than 36″ center to center.

Piping:

The contractor shall pipe steam to each curing room and place a steam jet in each room. He shall install sufficient radiation in each building so that the work room, office and sand-pit can be kept above 40° Fahr. in zero weather. All piping shall be made free from leaks.

There shall also be a water supply tank, unless water supply comes from city system, placed to afford a ready supply of water for the mixer and curing rooms. Water supply shall be carried to the mixer and three sill-cocks in each room, and to a sill-cock at one side of the building and another at the yard end of the building. Tank, if used, shall hold not less than 25 barrels.

Sand Screen:

The contractor shall furnish and properly install one revolving screen, 24″ diameter of ½″ mesh with 22″ screening surface.

Tile Machine:

The contractor shall furnish and properly install with shafting, etc., one drain tile machine complete.

Mixer:

The contractor shall furnish one concrete mixer, made to adjust to feed the proportions of sand and cement desired.

Steam Boiler:

The contractor shall furnish one steam boiler, 40 H. P., complete with injector, safety valve, try-cocks, blow-off cocks, gauges and grates, steel stacks, etc., same to be properly set, and fire-box to be lined with fire brick of good quality. The boiler and piping shall be subjected to a standard test before acceptance.

Engine:

The contractor shall furnish and set one 25 H. P. steam engine, with oiler, lubricators, all complete and properly connected to all machinery.

Belts, Pulleys and Shafting:

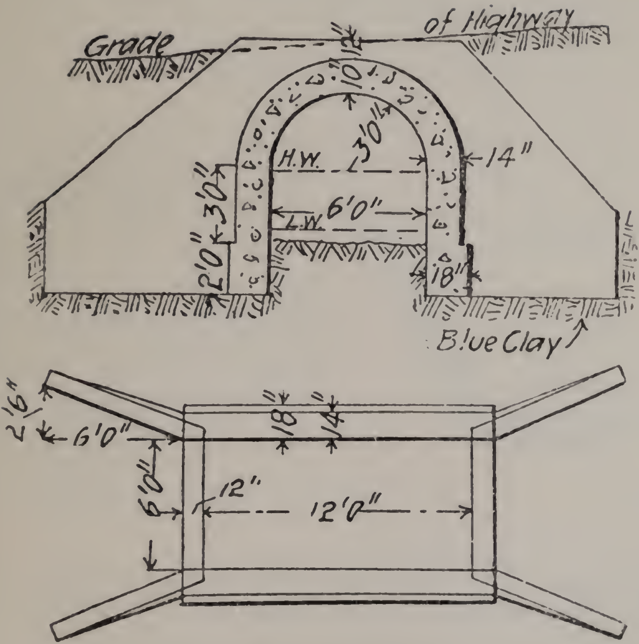
The contractor shall furnish all belts, pulleys and shafting necessary to connect the apparatus and put the plant in complete working order.

Concrete Tile Cars:

The contractor shall furnish one hundred standard concrete tile cars complete as per plans, with wheels, axles, etc., and three deck platforms made of 2″ plank.

Platforms:

Construct all platforms for unloading purposes as shown by plans, with frame work of 6″x6″ posts and girders and planked with good sound 2″ plank; all to be made good and substantial.



Plan and Section of Culvert.

(See Next Page)

COST OF A CONCRETE CULVERT.

We give below the figures showing the cost of constructing a 6′ arch culvert of concrete for a rural highway. The design of the culvert is shown by the sketch plan and section. It replaced a timber bridge with an 8′ opening, so that very little excavation was necessary. The cost was also reduced by the fact that the form lumber had been used previously and was used subsequently on similar work, and only the lumber actually wasted was charged to this particular job. There were 15 cu. yds. of concrete in the culvert. The concrete was machine mixed and wheeled 50 feet to the forms. The costs were as follows:

	Total.	Per Cu. Yd.
Excavation:		
1 man 1 day at $1.75	$ 1.75	$0.117
Concrete materials:		
17 bbls. cement at $2.50	$ 42.50	$2.833
17 cu. yds. gravel at $1	17.00	1.133
Totals	$ 59.50	$3.966
Mixing and placing concrete:		
2 men 3½ days at $1.75	$ 12.25	$0.817
Rent of mixer 4 days at $3	12.00	0.800
Moving mixer to work	2.50	0.166
Totals	$ 26.75	$1.783
Forms and centers:		
200 ft. B. M. lumber at $20	$ 4.00	$0.266
Hauling lumber to work	3.00	0.200
1 man 4 days at $2.50, making	10.00	0.666
Totals	$ 17.00	$1.134
Grand totals	$105.00	$7.000

CONCRETE USED AS A LINING FOR CALIFORNIA DRAINAGE DITCHES.

A water company in Southern California has lined its main canal and laterals with a thickness of concrete varying from 4″ for the larger canal to 2″ for the smaller laterals. The work of lining was done very thoroughly and with great care. Where the canal was an old earth ditch it was prepared for the lining and carefully finished as described. If the canal

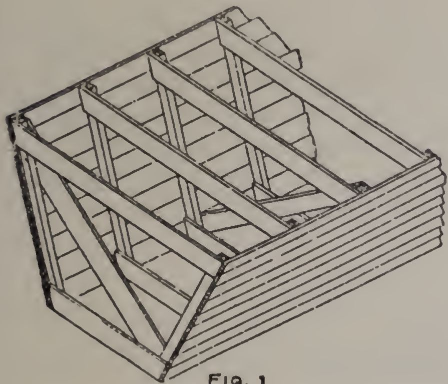


FIG. 1

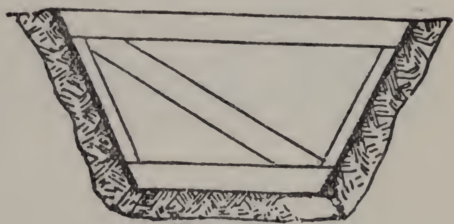


FIG. 2

had to be constructed and then lined, the excavation was made with shovels, and the excavation given an irrigation to settle and soften the ground. The excavated cross-section was made larger than the finished cross-section by the thickness of the lining, says the Irrigation Age. The bottom of the ditch was carefully graded and tamped so as to give a solid, smooth surface. A wooden form in the shape of a trough with no bottom was placed in the ditch. This wooden form was 16′ to 20′ long, depending on the size of the ditch, and to make it rigid the frames on which the side mold boards were nailed were placed 2′ apart, as shown in Fig. 1. The trough was placed in such a position that the axis of the ditch coincided with the axis of the form. Moist earth from the excavation was shoveled behind this form and was well tamped in successive layers; at least 6″ of earth was packed solidly in this manner, as shown in Fig. 2. The earth form was then removed and before the earth had time to dry the lining was put in.

Another form, smaller than the earth form, was used for the lining. For use in some of the laterals this form was given a peculiar shape with the idea of strengthening the lining and giving the ditch a slightly curved form at the bottom, the corners being rounded as shown in Figs. 3 and 4. The form was built with the usual side slopes of ½ to 1; the slope was

made more nearly flat for the lower 8″, where a slope of 1 to 1 was used. The depth of the form was equal to the depth of the lined section plus the thickness of the concrete. The form for larger canals was similar to the earth form. It was placed on the bottom of the finished earth ditch and

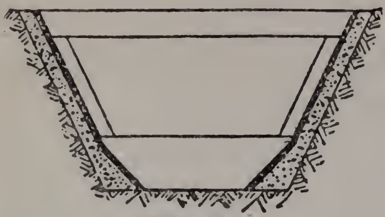


Fig. 3

Fig. 4

properly aligned; the concrete, which was mixed rather wet, was thrown into the space between the form and the earth and was well tamped. The side lining having been completed, the form was removed and the bottom lining put in. Wherever possible the concrete was kept wet while setting by allowing water to run in the ditch and retaining it with earth dams.

The concrete was made of 1 part cement to 7 parts of coarse gravel of varying sizes. The main canal which was lined has a bottom width of 5′, a depth of 4½′, and the thickness of the lining is 4″. Some of the smaller laterals are 8″ at the botom and 18″ deep, with a lining 2″ thick.

FIGURING THE COST OF CONCRETE DRAIN TILE, MACHINE-MADE.

Much has been written regarding the cost of the materials required for different sizes of tile; a manufacturer in Iowa will figure his cost perhaps 30 per cent lower than a manufacturer in Indiana, and a tile man in Minnesota will come to the front with a third figure. The seeker after information about the cost of making tile is bewildered.

The point is, tile-costs vary in different localities. A table of cost figures that is right for one state will be away off when applied in another state. The only safe method is to ascertain the cost of material and labor in your town and with a table of the materials required for different sizes of tile, figure your own costs.

The following figures showing the material required for 1,000 tile of different sizes, made on a machine, are from the new catalog of the Cement Tile Machinery Co., Waterloo, Ia., makers of the Schenk drain tile machine.

"It is almost an impossibility to figure the exact cost without testing your material, for a cubic foot of your material measured loose may pack into a more compact mass than a cubic foot of material found at some other point. However, this table can be taken as a basis to figure from.

Size	Cement	Sand
4″	3¼ barrels	2 yards
5″	4½ barrels	2½ yards
6″	6 barrels	3¾ yards
7″	7½ barrels	4½ yards
8″	9 barrels	5½ yards
10″	12½ barrels	7 yards
12″	17½ barrels	10½ yards
14″	24 barrels	14 yards
15″	27½ barrels	16½ yards
16″	32 barrels	19 yards

"C. W. Boynton, inspecting engineer for the Universal Portland Cement Co., has taken a great deal of interest in the cement tile industry, and under his supervision J. H. Libberton, of the same firm, recently made the following test at the plant of Griffen & Todd, Shabbona, Ill.

"Mr. Libberton made tests of both a 1:3 and a 1:4 mixture, using sand that weighed approximately 96 pounds to the cubic foot. Although these figures are absolutely correct for the material used at Shabbona, they might vary considerably with the material in another vicinity.

Size	Weight Lbs.	1:3 Mixture Tile Per Sack	Barrels Per 1000	1:4 Mixture Tile Per Sack	Barrels Per 1000
4″	7.1	54.0	4.6	63.0	4.0
5″	9.2	39.0	6.4	47.5	5.3
6″	12.8	30.5	8.2	39.3	6.4
7″	15.9	24.0	10.4	31.5	8.0
8″	20.5	19.0	13.2	24.0	10.4
10″	27.1	14.0	17.9	16.0	15.6
12″	41.4	9.5	26.3	11.0	22.8

"We give the following weights only as an average; the weight of a concrete tile depends largely on the aggregates used in its manufacture:

Size	Weight	Thickness
4″	6 pounds per foot	½″
5″	8 pounds per foot	9-16″
6″	11 pounds per foot	⅝″
7″	14 pounds per foot	11-16″
8″	18 pounds per foot	¾″
10″	25 pounds per foot	⅞″
12″	35 pounds per foot	1″
14″	48 pounds per foot	1¼″
15″	55 pounds per foot	1⅜″
16″	65 pounds per foot	1½″

"You may wish to figure the cost of shipping a car of tile. The following table will be found useful:

Size	Average	Car Load
4″	6,500 pieces	406 rods
5″	5,000 pieces	312 rods
6″	4,000 pieces	250 rods
7″	3,000 pieces	187 rods
8″	2,400 pieces	150 rods
10″	1,600 pieces	100 rods
12″	1,000 pieces	62 rods
14″	800 pieces	50 rods
15″	600 pieces	37 rods
16″	500 pieces	31 rods

HOW TO MOLD CONCRETE PARK AND LAWN BENCHES.

In the manufacture of ornamental concrete there is no other work that is more lucrative than molding benches for lawns and parks. The concrete worker will agree with this statement, but has doubtless hesitated to try the work for lack of instruction and the necessary molds. It is the purpose of this article to demonstrate the simplicity and ease with which common materials may be used for home-made molds that will produce artistic work.

A few words about molds will not be amiss. The metal mold is a necessity for work to be produced on a large scale in which the finish is to be uniform, but when we desire to secure the finish of cut or dressed stone we find that the metal does not give us the beautiful "sanded" effect that is possible with the sand or plaster mold. Most excellent results have been secured by coating the face-plates of a metal mold with glue and then applying fine sand to them before they were dry and, by coating with wax, to prevent sticking, have in this manner brought out the cut-stone effect desired.

To produce the design illustrated here will require some simple clay modelling which will be explained so that any person skilled enough to use a trowel can build a model for the work in clay. This, believed by many to be an art mastered by a favored few, is practical for the man with ingenuity and even slight artistic ability.

The model for the ends of the bench may be made either of wood or clay as desired. To model in clay, first lay out your design on a flat molding board that is several feet larger than the design, then with your clay mixed to the consistency of putty, pile it up inside the lines of the design marked out, to resemble the wood model in A, Fig. 1, and press together. The total length of the end is 43″; the greatest width is 23½″, aside from the bottom, which is 2″x6″x24″ and may be made of a plank that size fastened onto the clay model with screws when finished. As soon as you have the clay built up to the required thickness, or about 4″ for this work, take a sharp knife and cut off on the edges along the design you have marked on molding board; this will leave little spots unfilled in the model, which you can build up with soft clay and press down smooth with your finishing tool, which may be a small trowel. As the clay is plastic you have ample time to model it to the shape and smoothness desired and can build up any places that are hollow and cut off others that are too high, until you have it exact. Allow the model to dry before finishing the mold and handle carefully if the common clay mixture explained in this article is used.

The model for the ends may also be constructed of wood as shown by

A in Fig. 1. The boards are cut in the manner illustrated and nailed together, using four thicknesses of one-inch lumber and with a 2″x6″ plank 24″ long as the bottom, or base to rest upon the ground.

ASSEMBLING THE MOLD.

For the mold build a square box 30″x49″, inside, and 8″ high; in the bottom of this lay a course of wood fibre and sand mortar mixed one-half sand to one part wood fibre (plaster). Upon this lay your clay or wood model, which you have greased well so the plaster will not stick to it, and then fill the box to the top, or level with the model, with the plaster mortar and allow to dry. This plaster will become very hard in several days and can easily be cut with a saw into any shape. After the plaster dries, cut the mold into quarters, as illustrated, with a saw and remove the model, if it is not possible to "lift" it before cutting. The mold is held together with hooks and eyelets when molding and, as the mold is divided, it can easily be taken from the complete work. In Fig. 1, the box form is shown by B and the wood fibre mortar by C.

To mold the "mortise" in the ends of the bench to receive the seat and the back and to make a firmer bond, cut a 2″x2″ strip 19″ long, as shown by D; also one 18″ long as shown by E, and a 1″x2″ piece 2″ long as shown by E. Fasten these in the manner shown in Fig. 1, to two strips 32″ long, so as to reach across the entire mold; this may be hinged to one section of the mold so that the bottom edge of piece E is just 17″ from the base end of the model, which will bring the level of the seat 19″ from the ground; this may be changed to suit the manufacturer's ideas. The strips to mold this mortice are thus easily placed in the correct position each time and as easily removed when the mold is filled. As the base is 2″ wider on each side than the balance of the end, a 2″x2″ strip 32″ long placed across the mold allows that to be accurately molded each time.

With this work you must make a model for a right and a left end, as it will not be practical to use the same mold for both and have the mortises and ornaments. The opposite end of the bench is cast in a mold which is the reverse of the one described. The ornaments may be molded in clay or may be taken from many different sources. The carved ornaments from an old piece of furniture may be used, lightly tacking them to the wood model or fastening with small screws to the clay model, which can easily be done. In this regard the worker can easily secure from a local source the sawed and turned head and base blocks used for door trim, which are the same as shown at the top of the end in the illustration. The sawed brackets used for porches and cornices, when small, may be utilized with excellent effect to mold a neat ornament for the side arm of the end as illustrated in the completed park bench.

MOLDING THE SEAT AND BACK.

For the seat and back we will take a 5′ length for illustration; the right and left ends are placed side down on the ground, as shown in Fig. 1. For the top of the seat two boards, to make 17″ wide, are set up to make the inside form as shown by J. The inside of the back is molded by other boards joined together to make 20″ in width as shown by I; these boards

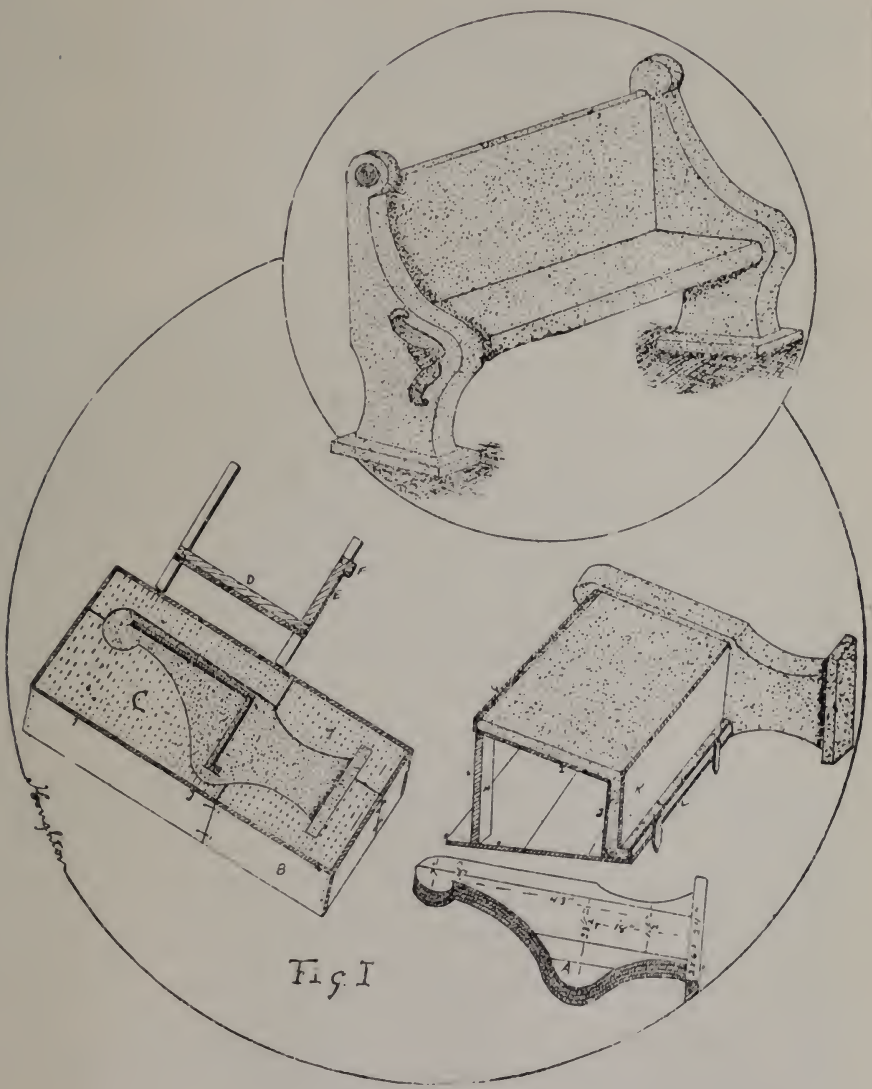


Fig. I

are nailed to the top edge of the seat board (J) and are supported at the other end by a prop or brace as shown by H. The top edge of the back is molded by a 3″ strip nailed to the edge of the inside back mold (I), and to this is nailed any hollow molding to make the top edge of the back round or oval; this strip is designated by G in Fig. 1. The bottom side of the seat is molded by an 18″ board (K); this is held in place by brace strips on the one side and rests on the concrete after it is laid for the roll or front edge of the seat. The 2″ strip (L) is held by stakes in the right position to mold the bottom edge of the roll on the seat. Any hollow molding that is wide enough may be laid on the pallet to mold the round edge on the seat in front, or even bevel strips may be employed for the purpose. The concrete is then placed and, as the forms are exactly at the edges of the mortices in the ends, the concrete for the sides and back has a greater chance to secure a good bond and be more secure from employing this "lock," as the weight or strain comes upon the end pieces and not upon the joint between the seat and the back and ends of bench.

The bench should be reinforced with rods in both seat and back. While there is more work to secure a "tie" between reinforcement in the ends of the bench, it may be accomplished by having the rods in the ends exposed inside the mortises; then bend the rods that go into the seat and the back and hook them over the exposed reinforcing rods in the ends, securing a strong tie and one that will sustain any probable weight placed upon the bench.

By this system of molding, one set of right and left end molds may be used to construct benches of any length, simply by having boards to mold the seats and the backs for benches of various lengths. This enables the operator to build anything from a one-person seat for a lawn to one of any length for a park or open-air auditorium. The width of the seats as planned is 18″ and the height of the backs, 19″, with a thickness of 2″. This thickness may be decreased or increased in placing the molding boards, without building new molds.

FINISHING THE WORK.

It is most necessary to have the seat and the back on the top side of very smoothly molded concrete so as not to injure the clothing of those who use the seat. The best method is to employ glass plates for this purpose. Sheets of glass are laid as a face plate on the boards (I) and also set against the boards (J) and a very rich mixture of cement and sand used as a facing course, care being used to have the sand very fine and carefully mixed with the cement. This coat employed as thin as it can be placed, will give a smooth and beautiful surface to the seat and back. A cheaper method is to use tin or sheet iron for this purpose, but it cannot be relied upon. A still more simple way is to rub the finished work, when it is rough, with a carborundum rubbing brick or cut it down with sand blast and then apply a brush coat of neat cement and water.

As the expense of these molds is very slight there should be a large profit for the concrete worker in the manufacture of this line of goods. They are in every way practical and have the advantage of being more durable than any other style of park bench.

CONCRETE LAWN OR PARK SEAT AND ARBOR IN A SIMPLE DESIGN.

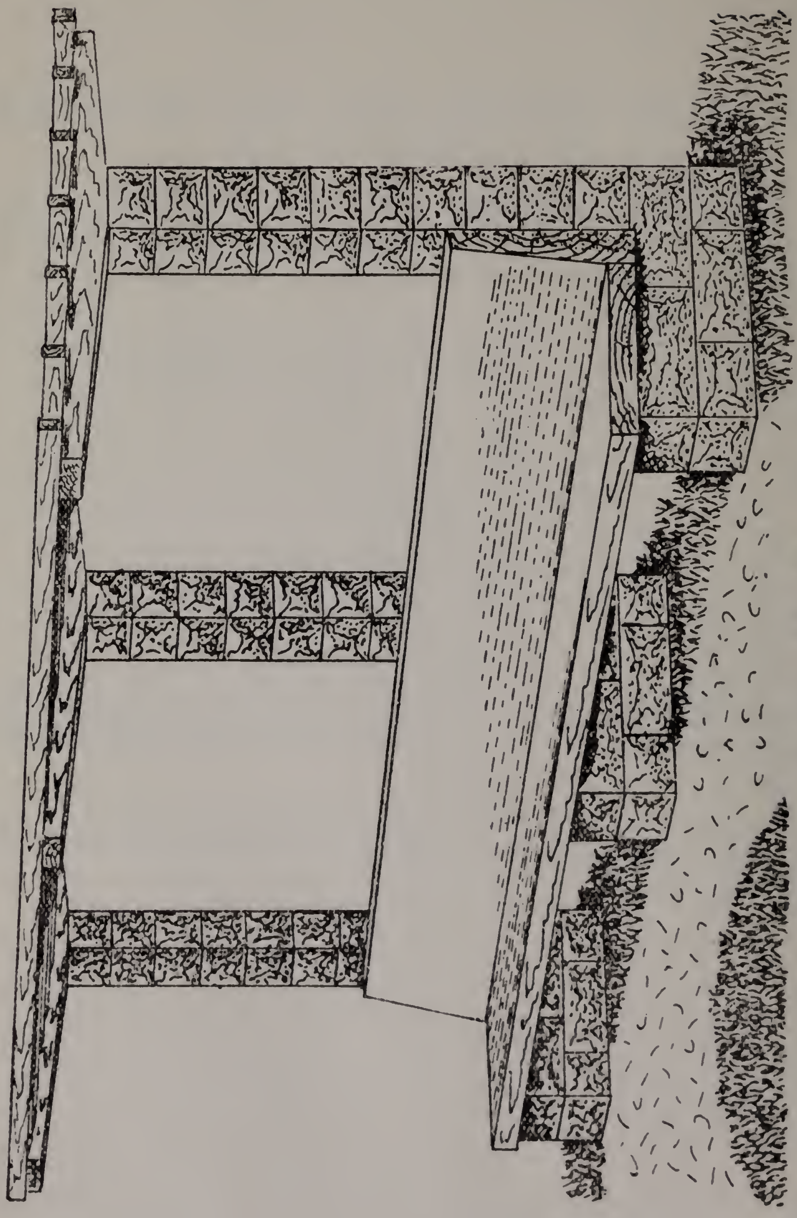
For a lawn or park that is too small to accommodate a regular pergola, the seat and arbor shown may be utilized with good effect. It may be made with any design of concrete block, and the seat may be of concrete or wood, as the owner elects.

Cost of the material required for its construction may be estimated according to local prices from the following list of requirements:

9 hollow block, 10″ x 24″ x 8″
36 hollow block, 10″ x 10″ x 8″
3 beams, 6″ x 8″ x 7′ 0″
7 rails, 2″ x 4″ x 12′ 0″
1 wooden seat, 3″ x 20″ x 10′ 0″
1 wooden back, 4″ x 2′ 0″ x 10″
21 lag bolts, ½″ x 7″
3 post anchor bolts, ¾″ x 2′ 0″

The lag bolts are used for attaching the rails to the cross-beams and the anchor bolts, embedded in the top courses of the hollow block, afford a means for attaching the cross-beams.

Ample protection is provided for vines, if planted just back of the seat. If desired, two seats may be arranged; in this case, the cross-beams should be 8′ long.



Concrete Block Arbor Seat 89)

AN EASY AND RAPID WAY TO MAKE HEXAGONAL BLOCK SIDEWALKS.

With the present method of building sidewalks of different colored hexagonal blocks, a vast amount of labor is required to mold the different blocks and set them in the walk, and expensive machinery is used for this purpose.

With the simple, rapid and effective machine described below the builder may lay the foundation of the walk as usual, and by simply setting the machine in place for each square and filling the spaces with the different colors of concrete mixture, mold an entire section of perfectly formed hexagonal blocks at one operation. This requires but very little more time than is necessary to lay a plain walk.

To make the machine, three pieces of one-eighth or one-fourth inch iron strips, two inches wide and seventy-one and one-half inches long, are required. At each end, these are bent upward two inches and holes are drilled in them for rivets; they are now bent as shown in Fig. 1, with the points of bending exactly eleven and one-fourth inches apart, and at an angle of about 40 degrees. These make the three center parts of the machine, as shown in Fig. 2.

Five strips are now cut fourteen inches long from the same size iron and bent two inches at each end, through which holes are drilled for rivets; these are riveted to the three center parts of machine as illustrated in Figs. 1 and 2, and form an hexagonal mold that is exactly twenty inches across at its two widest points.

To the sides of these strips of the same sized material forty inches long are riveted as shown in Fig. 2. These strips project five inches beyond the point of riveting and so are at the ends of same in exact line with the widest points of the center strips, and form the sides of the walk as fast as laid.

To the two side strips of iron four handles are riveted, as shown in Fig. 2, to make the device easy to handle.

HOW IT WORKS.

In operation, the base of the walk is laid, the machine is set upon it, the spaces filled with the different colors of concrete mixture desired, and the top leveled off. The machine is then lifted and set upon the next space, and the edges of the hexagonal blocks finished with the pointing trowel; during this operation any small particles of mortar that lift with the machine can be pressed back into place, making each block perfect in shape and color.

The machine as illustrated will mold a section of walk five feet wide and forty inches long. This length can be increased by adding more

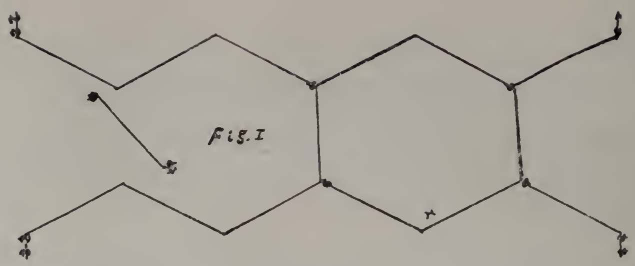


Fig. I

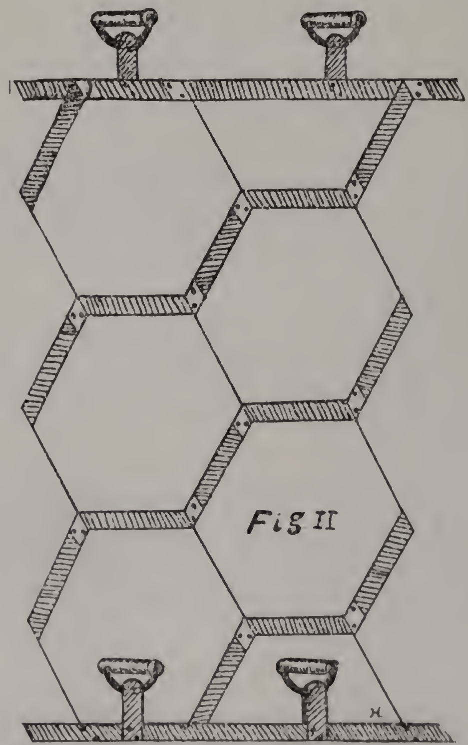


Fig II

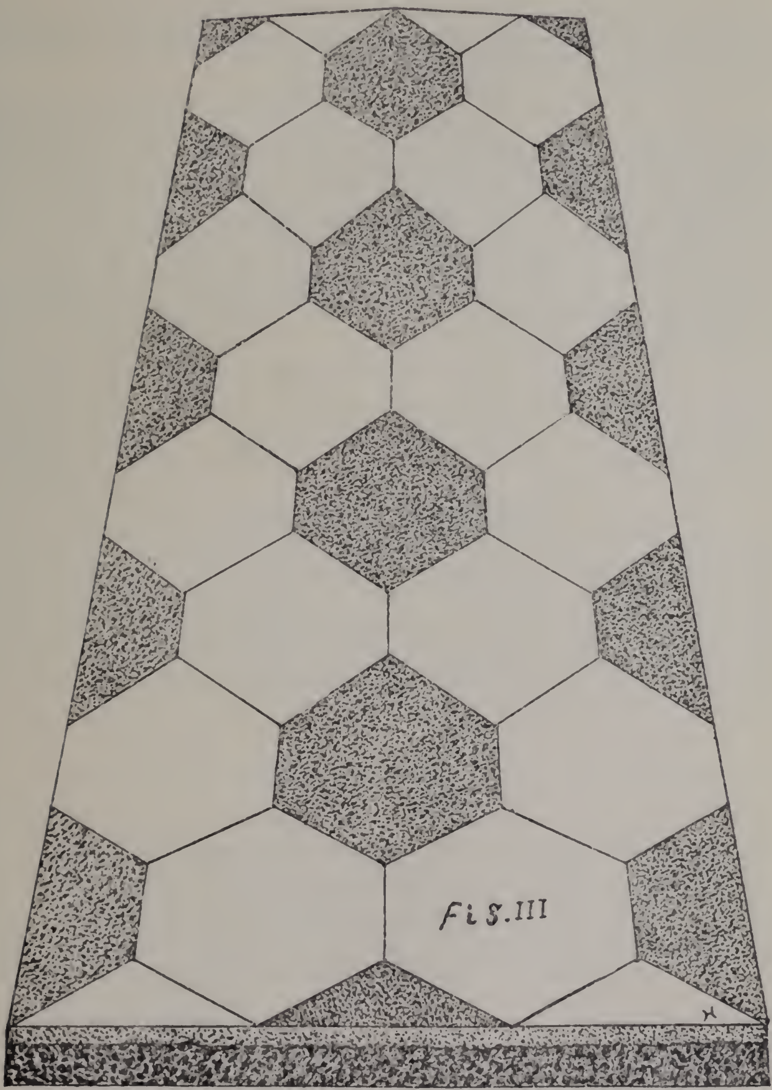


Fig. III

sections, which can be fastened together if desired, but by having the machine so that it can be easily handled by two men the work will be more rapid and is more neatly done.

For walks of a width greater than five feet, the length of the centers may be easily increased to make the mold of the proper width; or two sections may be set side by side when walks ten feet wide are constructed.

In Fig. 3 a section of the walk constructed with this machine is shown. This gives you an idea of the method of using the two colors of concrete, as well as the appearance of the finished walk.

This style of sidewalk has one big advantage over the plain square sections, as each section is separate and distinct, and while it is all laid at the one operation, this one feature removes all danger of cracking by the freezing of the soil under the walk, as well as the trouble sometimes caused by the roots of trees. The walk has every chance to adjust itself to these conditions without causing unsightly cracks in the blocks or sections.

Again, this style of sidewalk will command a much better rate than the plain sections, and with the aid of this simple machine can be built at very little additional labor and expense.

PAVING FOND DU LAC, WIS., STREETS WITH CONCRETE.

Municipal officers all over the country are taking great interest in the subject of concrete pavements. In a number of cities concrete pavements are being laid this season and if they make good, concrete will be substituted next year on some of the largest paving jobs now contemplated.

An inexpensive and satisfactory method of laying concrete pavement has been worked out in Fond du Lac, Wis., under the supervision of City Engineer J. S. McCullough.

The street is prepared as for any other form of paving, with a heavy steam roller, and drainage is provided where necessary, but is not needed for concrete paving any more than for other paving. The specifications quoted below are clear and concise and attention is called to the placing of the expansion joints.

These pavements permanently retain the surface grade, satisfactorily stand the climatic conditions and are the most sanitary as well as the handsomest pavement that can be laid. They become more durable with age and will outlast any other kind of pavement. The city of Fond du Lac has laid this year about five miles of this pavement, at about one-half the cost of brick, which is even cheaper than asphalt, creosoted wood or granite block.

SPECIFICATIONS.

Foundation.

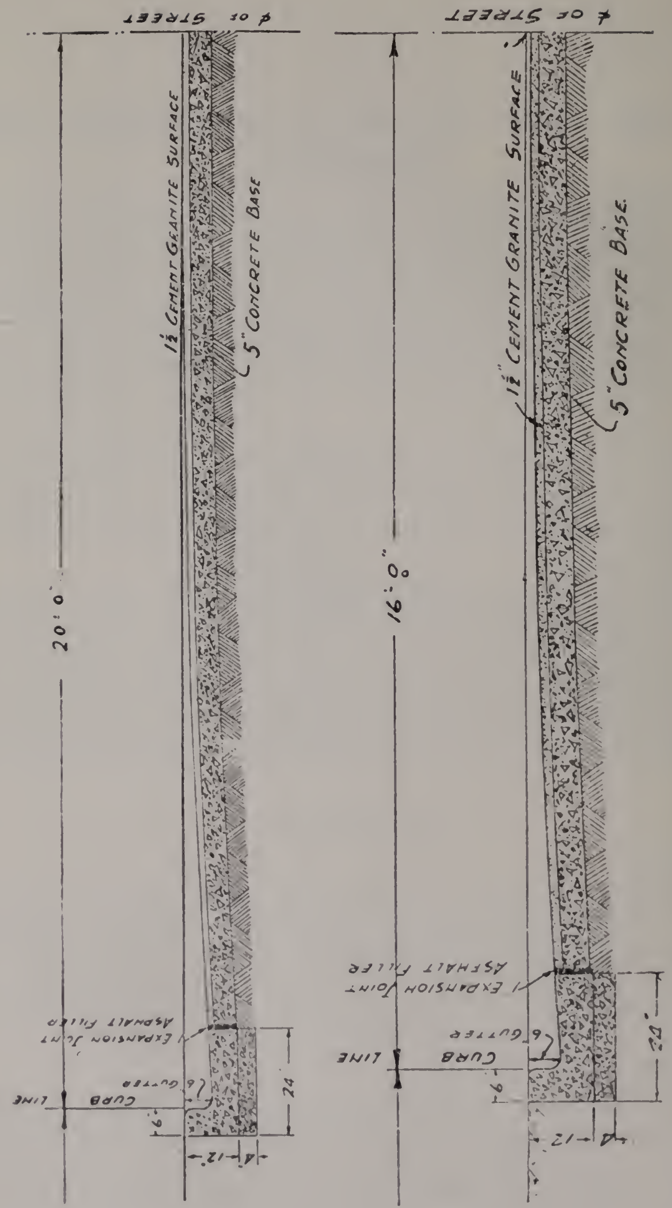
The concrete foundation shall consist of 5″ Portland cement concrete mixture, 1 part cement, 2½ parts sand, and 5 parts clean, crushed limestone; the cement, sand and stone to conform to specifications. The foundation to be laid as specified, thoroughly tamped in place, and shall be uniformly 5″ thick at all points after having been compacted.

Wearing Surface Composition.

After the concrete foundation has been placed and before it has begun to set, there shall be placed thereon a wearing surface 1½″ thick, composed of 1 part Portland cement, 1 part clean sharp sand and 1 part granite screenings; the granite screenings to contain no particles larger than ¼″ in size, and not more than 10 per cent less than 1-16″ in size.

Mixing.

The above material shall be thoroughly mixed dry and then mixed with water enough to form a rather wet facing mixture.



1½" Cement Granite Surface
5" Concrete Base
20' 0"
16' 0"
Curb Line
6" Gutter
1" Expansion Joint Asphalt Filler
24
22
12
4
6

How Laid.

The wearing surface shall be deposited in two layers, the first, ½″ thick, to be thoroughly rammed to insure perfect contact; the second, 1″ thick, to be applied immediately after and thoroughly troweled, and made to conform to the established grade and cross-section of the street by the use of proper forms. When sufficiently hard, the surface is to be floated and steel troweled; after this has been done and all depressions and uneven spots brought to a uniformly true and even surface, the pavement shall be roughed up by lightly drawing a common street broom over the surface, square across the street, from curb to curb. Care shall be taken to obtain a surface free from ridges at the expansion joints, and depressions or unevenness in the surface that will detract from its appearance, or cause water to lie on the pavement. Any sections having such inferior surface will be rejected and shall be rebuilt by contractor at his own expense.

Expansion Joints.

The foundation shall be laid in sections, with an expansion joint at least every 50′, extending from curb to curb, square across the street, and from sub-grade up through the entire thickness of the pavement.

A similar expansion joint shall be provided along each gutter between the pavement proper and the gutter slab, and where otherwise designated by the engineer. Care shall be taken to make the expansion joint in such manner that it is practically the width designated by the engineer throughout its depth. Any joints showing wider on top than designated will not be accepted and such work will have to be rebuilt. Extreme care must be exercised in removing templets or frames used to make expansion joints; the breaking out of any portion of the pavement in removing such templets and forms, will not be tolerated, and any such damaged portions of the work shall be torn out and replaced in good condition by the contractor at his own expense.

Filler for Expansion Joints.

After the concrete pavement is sufficiently hardened the expansion spaces shall be cleaned of all loose dirt, cement, sand and refuse, and filled with an asphaltic filler acceptable to the engineer.

Sprinkling.

The contractor shall keep pavement sprinkled for one week after it is laid or longer if deemed necessary by the engineer.

CONCRETE PAVEMENTS

Concrete pavements have been laid in many cities in this country, as noted elsewhere in this book, and in most cases have given the best satisfaction. In some cities the pavements have been laid according to specifications very like those for sidewalks, the top coat of the pavement being roughened to give better foothold to horses. There are two patented forms of concrete pavement for cities, the Blome "granitoid" pavement and the Hassam "compressed concrete" pavement. There is also a special block pavement used for automobile roads in Florida.

BLOME PAVEMENT.

The Blome pavement is laid on a natural sandy or gravel foundation, rolled to an even surface, or, in the case of weak soils, on a prepared foundation of sand, gravel, or crushed rock, 3″ thick. A first course of concrete 5¼″ thick and a wearing coat 1¾″ thick complete the pavement. The first course is of concrete mixed in the proportion of one part Portland cement, three parts sand not larger than ⅛″ and four parts crushed limestone, trap rock or gravel, not larger than 1½″. This course is thoroughly tamped.

Before the first coat has begun to set the finish coat is applied, mixed two parts Portland cement and three parts clean, crushed granite, trap rock, hard stone, gravel or boulders, free from dust. Fifty per cent of the aggregate should be ¼″ size, thirty per cent ⅛″ and twenty per cent 1-16″, with all fine particles screened out. This coat is applied rather wet and is divided off into rectangles 4½″x9″. Expansion joints are placed where indicated by the engineer. The specific process described here is controlled by patents.

HASSAM PROCESS.

The Hassam patented concrete pavement consists of a single thick course of concrete, finished with a rough wearing surface. After the foundation has been prepared, crushed stone of varying size is laid on to a thickness of 8″. A steam roller is used to compact this stone bed until the smallest possible per cent of voids is secured. While the rolling process continues, thin cement grout, mixed one part Portland cement to two parts sand, is poured into this stone bed. The grout is applied until it fills all the voids in the stone and, under the stress of rolling, flushes to the top. Onto this surface is spread a thin layer of pea stone. This layer is thoroughly rolled and the stone are spread thickly enough to insure filling all the surface voids. As the small stone are compressed and made a part

of the first coat, they present a roughened surface for traffic. This process of paving is patented. The completed pavement is at least 6″ thick.

DICKSON BLOCK ROAD.

The Dickson concrete roadway is built of patented concrete block. Two wheel tracks are laid, forming parallel lines along the road. Each block presents, in cross section, the form of the letter H. The block are reversible; when one surface has been worn down the block can be removed and turned over. Grooves and tongues in the block ends insure their locking. Each block is 12″ wide, 8″ high and 24″ long. The hollow in the top, in which the vehicle wheels run, is 1½″ deep, 6″ wide at the bottom and 8″ wide at the top, leaving a 2″ flange on each side. These block are laid on gravel foundation, the 2″ flanges being flush with the rest of the road. These two lines of block receive the wheels of vehicles. It is stated in behalf of this pavement that, given the molds, the block can be made right where they are to be laid, from material secured along the highway. The roadway presents a surface that is welcomed by the automobilist, and at the same time is hard enough to resist the wear. It is stated that this roadway can be constructed at a saving of from $1,500 to $1,800 per mile over other forms of country road construction.

AMOUNTS OF MATERIALS REQUIRED FOR CONCRETE SIDEWALK CONSTRUCTION.

The following tables, reprinted from *Engineering-Contracting*, will be found most useful by builders of cement sidewalks, giving, as they do, the quantities of materials required per 100 square feet of sidewalk, ranging in thickness from three to seven inches. Table 1 gives separately the volume of base concrete and surfacing mortar in 100 square feet; Table 2 gives for each of the thicknesses and mixtures named the amounts of cement, sand and stone required per 100 square feet.

Computations are based on the assumption that a barrel of cement, measured loose, as is customary in sidewalk work, contains 4.4 cubic feet. For finishing mortar, the voids in the sand amount to 45 per cent.; for base concrete the voids are assumed to be 40 per cent for sand and 45 for stone.

In "Concrete Construction—Methods and Cost," by Gillette and Hill, the amounts of materials per cubic yard of mortar and concrete are as follows:

Mortar proportions	1:1	1:1½	1:2
Barrels of cement	3.94	3.34	2.90
Cubic yards of sand	0.6	0.8	0.9
Concrete proportions	1:2:5		1:3:6
Barrels cement	1.16		0.90
Cubic yards sand	0.38		0.44
Cubic yards stone	0.95		0.88

Table 2 has been computed from the above quantities and those given in Table 1; thus, for a three-inch base (Table 1) there will be required 0.93 cubic yards for 100 square feet. If the base is 1:2:5, then the cement equals 0.93 cubic yards × 1.16 bbl., or 1.08 bbl.

Sand equals 0.93 cu. yd. × 0.38 cu. yd., or 0.35 cu. yd.

Stone equals 0.93 cu. yd. × 0.95 cu. yd., or 0.88 cu. yd.

In estimating, the following method is used: Suppose it is desired to find the amount of cement, sand and stone required for 1,000 square feet of sidewalk, five feet wide, with a four-inch base, 1:2:5, and a one-inch wearing surface, 1:1½.

From Table 2 we have:

	Cement.	Sand.	Stone.
Per 100 sq. ft.	bbls.	cu. yds.	cu. yds.
Base, 4 ins.	1.43	0.47	1.18
Wearing surface 1 in.	1.03	0.247	....
Total per 100 sq. ft.	2.46	0.717	1.18
	50*	50	50
Total per 5,000 sq. ft.	123.00	35.850	59.00

*1,000 × 5 = 5,000 ÷ 100 = 50.

* * *

Table I.—Showing volume of concrete base and mortar wearing surface per 100 sq. ft. of concrete walk of various thicknesses.

Concrete Base. Thickness, ins.	Volume, cu. yds.	Mortar Wearing Surface. Thickness, ins.	Volume, cu. yds.
2½	0.77	½	0.155
3	0.93	¾	0.232
3½	1.08	1	0.309
4	1.24	1¼	0.386
4½	1.39	1½	0.464
5	1.55	1¾	0.541
6	1.87	2	0.618

NOTE.—100 sq. ft. of walk 1 in. thick has a volume of 0.309 cu. yd. To get the volume in a walk of any thickness, multiply 0.309 by the thickness of the walk in inches, e. g., 0.309 cu. yd. × 6 in. equals 1.87 cu. yd.

Table II.—Showing quantities of cement, sand and broken stone required for 100 sq. ft. of sidewalk separately for base and for surface finish for different proportions of concrete and different thicknesses of walk.

Thickness, ins.	Cement, bbls.	Sand, cu. yds.	Stone, cu. yds.	Cement, bbls.	Sand, cu. yds.	Stone, cu. yds.
2½	0.89	0.29	0.73	0.69	0.34	0.68
3	1.08	0.35	0.88	0.84	0.41	0.82
3½	1.25	0.41	1.02	0.97	0.47	0.95
4	1.43	0.47	1.18	1.12	0.55	1.09
4½	1.61	0.53	1.32	1.25	0.61	1.22
5	1.79	0.59	1.47	1.39	0.68	1.36
6	2.17	0.71	1.78	1.58	0.82	1.64

Thickness, ins.	Cement, bbls.	Sand, cu. yds.	Stone, cu. yds.	Cement, bbls.	Sand, cu. yds.	Stone, cu. yds.
½	0.61	0.093	0.52	0.124	0.45	0.139
¾	0.91	0.139	0.77	0.186	0.67	0.209
1	1.12	0.185	1.03	0.247	0.90	0.278
1¼	1.52	0.232	1.29	0.308	1.12	0.347
1½	1.83	0.278	1.55	0.371	1.34	0.418
1¾	2.03	0.325	1.81	0.433	1.57	0.487
2	2.33	0.371	2.06	0.494	1.79	0.556

FIGURES OF COST OF CONCRETE SIDEWALKS.

Cost data relative to concrete sidewalk construction are always valuable, though figures vary in different sections of the country. We print here cost figures on two different sidewalk jobs, one a 5′ walk with curb, the other a 4′ walk with curb.

The 5′ walk was 625′ long, with a 6″ curb, and the actual amount of money expended by the contractor for material and labor appears in the following itemized statement:

For Material—	
60 cu. yds. cinders at 85 cents per cu. yd	$ 51.00
79 cu. yds. screened gravel at $1.50 per cu. yd	118.50
24 cu. yds. sand at $1 per cu. yd	24.00
9 cu. yds. pea gravel at $1 per cu. yd	9.00
3 tons crushed granite at $3.50 per ton	10.50
87 barrels cement at $1.75 per barrel	152.25
Water	2.61
Tile, 625 at two cents each	12.50
	$380.36
For Labor—	
One foreman—six days at $3.50 per day	$ 21.00
One head layer—four days at $2.75 per day	11.00
One assistant layer—four days at $2.50 per day	10.00
Seven laborers—six days at $1.80 per day	75.60
Three teams, hauling away excavated material, two days at $4.50	27.00
	$144.60
Total cost—Material	$380.36
Labor	144.60
625 linear feet cost	$524.96

Or 82.99 cents per running foot.

In the second job the 4′ walk was 455′ long, with curb. The cost figures follow:

For Material—	
30 cu. yds. screened gravel at $1.50	$ 45.00
18 cu. yds. sand at 85 cents	15.30
24 cu. yds. cinders at 75 cents	18.00
8 cu. yds. pit gravel for filling at $1	8.00
6 cu. yds. pea gravel at $1.50 per cu. yd	9.00
52 barrels cement at $1.70 per barrel	88.40
Tile, 455 at two cents each	9.10
Water	2.08
	$194.88
Labor—	
One foreman—five days at $3.50 per day	$ 17.50
One head layer—three days at $3	9.00
One assistant layer—three days at $2.50	7.50
8 laborers—five days at $2	80.00
	$114.00
Total cost—Material	$194.88
Labor	114.00
455 linear feet cost	$308.88

Or 70 cents per running foot.

ALL CONCRETE WIRE CONDUITS AS USED IN ST. LOUIS.

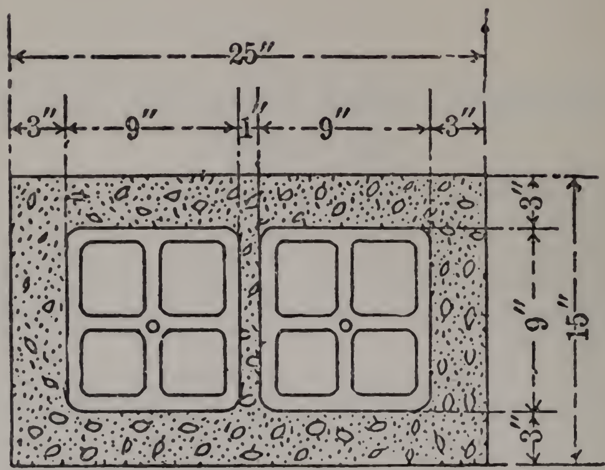
The almost universal practice in this country of constructing underground conduits for wires and pipes has been to use multiple clay tile, wood fiber or iron pipes. These have generally been surrounded by concrete. The common practice has been to lay a bed of concrete in the trench, lay on this the ducts and then place the remaining concrete around the sides and on top of the duct line.

It has been noticed that under this system the concrete bed is left unprotected during the placing of the ducts and a good deal of dust and dirt falls onto the exposed concrete, so that when the balance of the concrete is placed the bond is imperfect. Thus the completed line acts as two beams instead of one, with greatly reduced strength.

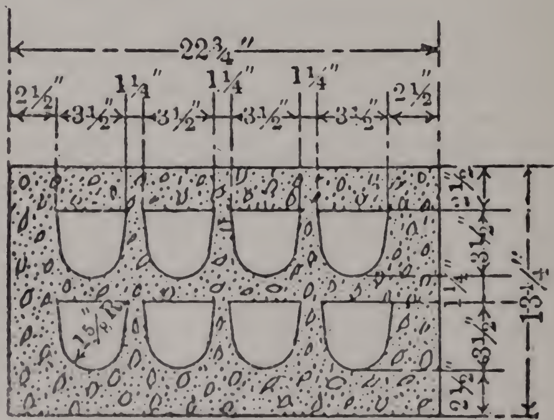
Another objection to this method of providing underground ducts for wires is that the successive sections of clay or other tiles cannot be perfectly aligned, no matter how much care is taken in placing them.

In the last three years the city of St. Louis has laid more than 170,000 duct-feet of all-concrete, or monolithic conduits. This construction occupies less space for a given number of ducts of equal size, permits perfect inspection of the entire length of each duct after the greater part of it has been constructed, and provides a smooth straight duct opening free from all joints or possible intercommunication between ducts, and furnishes a monolithic, and hence stronger structure.

The construction of the monolithic duct is carried on as follows: After the excavation of the trench duct form supports are set to grade and alignment 16′ apart, these supports being intended to hold in place the forms or molds for producing the duct openings. These forms consist of 16′ sections of clean, straight-grained lumber, U-shaped in cross section, which produce a duct having a semi-circular bottom and a flat top. The forms are placed in the supports above referred to and are held down against the buoyant force of the semi-liquid concrete by heavy weights. The concrete is then "puddled," rammed around the forms and struck off level with the tops of the molds. In a few hours, after this concrete has taken its initial set, the duct forms are removed by carefully lifting them vertically, when any cavities or other imperfections in the duct can easily be remedied by trowel. Then smooth slabs of concrete of sufficient width to just lap over each outside duct are laid as a cover to the duct openings, and just enough mortar applied to seal the joints. On this a second layer of concrete containing duct openings is laid in a similar manner. When the desired



CONCRETE AREA 214.70 SQ.IN.
CONDUIT " . 97.04 " "
CONCRETE REG'D
PER DUCT FT. 0.19 CU FT.



CONCRETE AREA 217.92 SQ.IN.
CONDUIT " 89.52 " "
CONCRETE REG'D
PER DUCT FT. 0.19 CU. FT.

number of tiers of ducts is thus laid, the top of the conduit is formed by placing on the concrete slabs covering the top ducts a top layer of concrete about 2½″ thick. "Blind" manholes for service boxes are easily molded in this structure wherever desired. The thickness of concrete between the ducts and the bottom and sides of the trench is likewise made 2½″.

The amount of concrete required does not differ very largely from that required for multiple tile ducts; the amount being practically the same for a six-duct conduit, and about 1-3 more for 20 ducts or higher. From the construction at St. Louis it was found that while multiple tile conduits cost from 7 to 9 cents per duct-foot for a 6-duct conduit, monolithinc conduits cost about 4 cents. The same relation held practically constant for all larger conduits, 24-duct conduits costing from 5¾ to 7¾ cents per duct-foot for multiple tile and only about 3 cents for monolithic conduit. Two-duct conduits cost about 6 cents per duct-foot for monolithic and from 11 to 13 cents for multiple tile.

REINFORCED CONCRETE GUTTER COVERS AT CROSSWALKS.

The usual form of crosswalk ends at the outer edge of the gutter and the gutter is bridged with 2″ planks or cast iron covers, says *Engineering-Contracting*. On streets paved with brick or asphalt, having a part of the surface raised to do duty as a crosswalk on the sidewalk level, it is common practice to leave an opening 6″ to 8″ wide without a cover. Many sprained ankles are reported because of this practice.

Reinforced concrete slabs are being used as gutter covers and the following data given by an engineer who has used such slabs may be useful. The steel is assumed to be stressed 16,000 lbs. per square inch, the concrete 600 lbs., with ratio of deformation of 15. Such slabs may be made by prisoners or in the corporation yard during months when other work is stopped. They are made in the widths and lengths required, are carried like wood or iron covers to points where needed and require no fastening in place. They will not rust nor rot, so that the maximum economy results from their use.

The following table gives the total thickness, in which the center of the steel is assumed to be ¾″ from the bottom. This fact must be remembered in handling the slabs. They are calculated for a total load of 200 lbs. per square foot, which, on the assumption mentioned above, assures a factor of safety of 4 at 30 days after manufacture, increasing to nearly 7 when the slabs are six months old. In these slabs use a 1:2:4 mixture, considering one bag of cement (gross weight 95 lbs.) as equivalent to 1 cubic foot. The stone should range from pea size to material passing a ¾″ mesh. The water by measure should be equal to the cement.

The steel necessary is given in square inches per foot width in the accompanying table. Round rods or square bars may be used, but fabricated reinforcement is apparently favored, expanded metal and wire mesh being about equally regarded.

TABLE OF GUTTER SLABS.

Clear span.	Total length of slab.	Thickness ins.	Steel area sq. ins. per ft. width.
1′ 6″	1′ 10″	1½	0.063
2′ 0″	2′ 4″	2	0.084
2′ 6″	2′ 10″	2¼	0.103
3′ 0″	3′ 6″	2¼	0.12
3′ 6″	4′ 0″	2½	0.14
4′ 0″	4′ 6″	2¾	0.145
4′ 6″	5′ 2″	3¼	0.185
5′ 0″	5′ 8″	3½	0.205

The reinforcement goes from one support to the other in the amounts given. With fabrics the cross-bearing steel is of course provided. When rods or bars are used an area equal to one-third that given in the table should be placed transversely.

For spanning square or circular openings, such as manholes and coal holes, use 50 per cent more steel, placing half in one direction and half at right angles to it, maintaining the slab thickness.

ASSOCIATIONS OF CEMENT USERS.

Every man connected with the concrete business directly or indirectly should be a member of at least one association of cement users. There is only one country-wide organization, the National Association of Cement Users. There are a number of smaller organizations devoting their activities to the interests of the industry in certain prescribed territory.

We print below a list of the organizations which are striving to promote prosperity in the concrete industry, with a definite address of an official of each association. These officials will be glad to furnish further information upon request.

National Association of Cement Users. President, Richard L. Humphrey, Harrison Bldg., Philadelphia, Pa.

Cement Products Exhibition Co., Commercial National Bank Bldg., Chicago, Ill. Secretary-Treasurer, J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Northwestern Cement Products Association, 410 Pioneer Press Bldg., St. Paul, Minn. Secretary, A. E. Pfiffner, 404 Globe Bldg., St. Paul, Minn.

Iowa Association of Cement Users. Secretary, Ira A. Williams, Ames, Iowa.

Nebraska Cement Users' Association, York, Neb. Secretary-Treasurer, Peter Palmer, Oakland, Neb.

Oklahoma Cement Users' and Contractors' Association. Secretary, D. C. Patterson, 336 Bassett Bldg., Oklahoma City, Okla.

Concrete Machinery Manufacturers' Association. Secretary, S. L. Wiltse, Jackson, Mich.

Canadian Cement and Concrete Association. Secretary, A. E. Uren, care Canadian Cement and Concrete Review, Toronto, Ont.

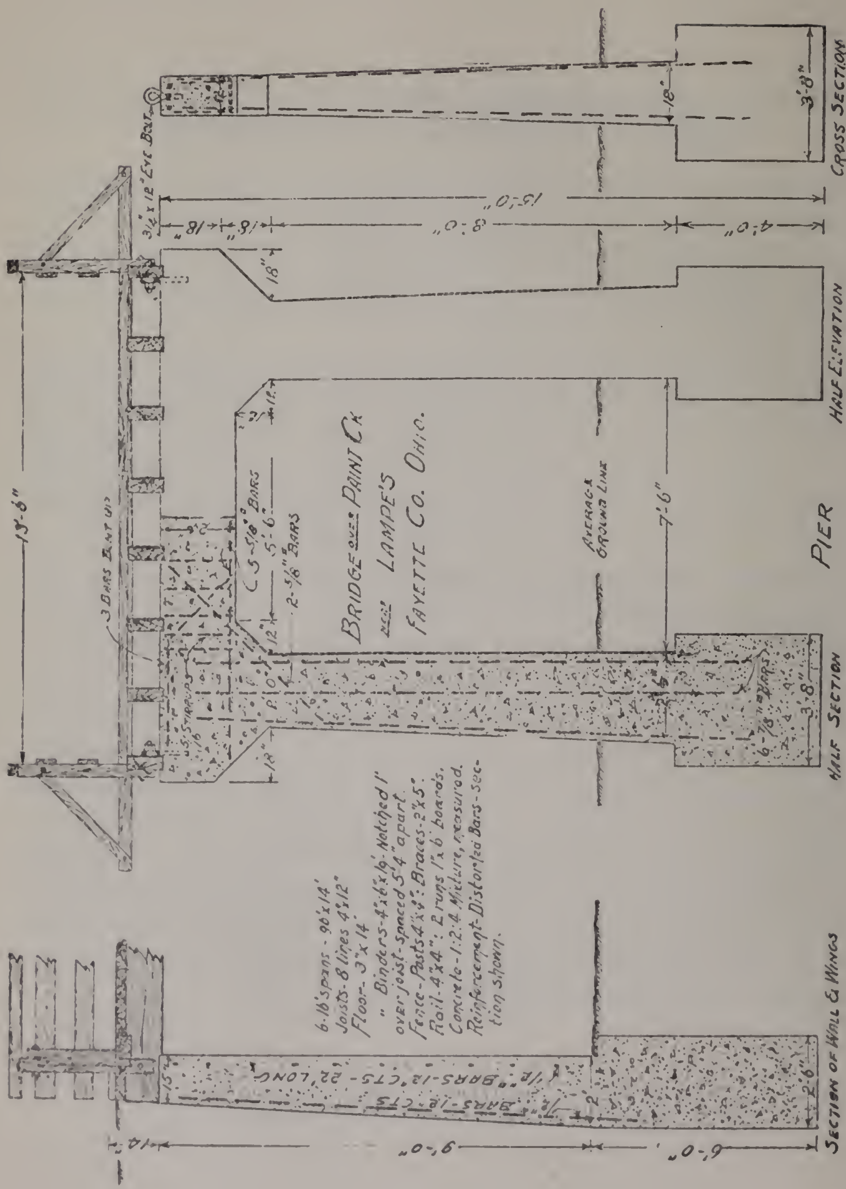
SIMPLE AND SENSIBLE BRIDGES FOR HIGHWAY USE, CONCRETE, AT LOW COST.

We illustrate herewith the general plan and two views of two highway bridges of concrete, recently built near Washington Court House, O. One, the so-called Jones bridge, had abutments and piers 15′ high, while the Lampe bridge substructure was 18′ high; but both structures were practically identical in design and in execution.

The engineer's estimate of the cost of the Jones bridge was $1,174, divided as follows: Lumber, 8,593 feet, b. m., for superstructure, $279; bolts, nails, labor and so on, for superstructure, $38; two concrete abutments, 72 cubic yards, $432; five concrete piers, $189; metal reinforcement, 3,700 lbs., $111; all other material and labor for substructure, $125. The contract price of the bridge was $1,167.

For the Lampe bridge, the engineer's estimate of the cost was the same, plus cost of the added height of the abutments and piers, or a total of $1,291; the contract price, for which the bridge was actually built, was $1,262.

The bridges were built under the supervision of Frank M. Kennedy, county surveyor, who says: "This type of bridge is well adapted to country roads, where the travel is light, and one of the primary objects is to keep the cost at a minimum. They are best suited for spanning comparatively slow streams, where little drift is carried in high water. The life of the wood superstructure is about 8 to 12 years, but it may be replaced at any time with reinforced concrete. This year we shall build two more bridges of the same general plan, with 20′ span and reinforced concrete floors, with the butts of the piers increased to 4′ square.


Bridge over Paint Ck
near Lampe's
Fayette Co. Ohio.
Pier
Half Section
Half Elevation
Cross Section
Section of Wall & Wings
Average Ground Line

CONCRETE THEATERS, SCHOOLS, BANKS AND LIBRARIES.

Contractors who have to submit bids to school boards, library commissions, city councils and other public bodies often encounter strong opposition from dealers in materials other than concrete. In such cases it is helpful to know just where some other town has built a concrete school building or library, so the board can be referred to it. So we print below a list of the cities in which such buildings have been built, and where possible we have added the names of the builders and architects. By referring to these actual examples it may be possible to swing a contract in connection with which there is a prejudice against concrete construction. Most of the buildings mentioned are built of block.

Banks.

Lankin, N. D.

First National, Newport, Wash. Chas. F. Craig, builder.
Bank and Residence, Wm. McFarlane, Blencoe, Ia.
Vancouver, Wash.
Northern Trust Co., Edgewater, N. J. Buckley & Godstrey, builders.

Theaters.

Gayety Theater, Toronto, Ont. G. W. Gouinlock, architect.
Empress Theater, Vancouver, B. C. Concrete Engineering & Construction Co., builder.

City Hall.

Cambridge Springs, Pa. Hercules Stone Co., builder.

Libraries.

Public, Iola, Kans. Horton Concrete Co., builder.
Carnegie, Woodstock, Ont. Chadwick & Beckett, architects.

Schools.

Margaret Eaton School, Toronto, Ont. W. R. Meade, architect.
High School,East Toronto, Ont. W. R. Meade, architect.
Public School, Waynesboro, Va. M. R. Ellis, Basic City, Va., builder.
Staunton Military Academy, Staunton, Va. Larner & Smith, builders; T. S. Collins & Sons, architects.
City High School, Dallas, Tex. Dallas Cement Stone Works, block; Crisman & Nesbit, builders; Lang & Witchell, architects.
Normal School, Hamilton, Ont. F. R. Heakes, architect.
Public School, Syracuse, N. Y. Onondaga Pressed Stone Co., builder.

Polytechnic School, Fort Worth, Tex.
Public School, Fort Worth, Tex.
Public School, Lodi, Cal. Perrin Bros., builders.
Public School, Bethany, Mo. J. H. Friend, builder.
Public School, Viequez, Porto Rico. F. P. Hatch, builder.
College St. Pierre, Plattsburgh, N. Y. Boissy & Brault, builders; Ralph S. Signor, architect.

School 44, Indianapolis, Ind. (reinforced concrete). John A. Shumacher Co., builder; H. C. Brubaker & Co., architects.

South Side School, Mishawaka, Ind. Concrete Manufacturing & Construction Co., builder.

High School (stucco), San Jose, Cal. Z. O. Feld, builder; F. S. Allen, architect.

Public School, Grand Marais, Minn. Clyde W. Kelly, Duluth, architect.

Public School (reinforced), Duarts, Cal.

THE MANUFACTURE OF CONCRETE MONUMENTS AS AN INDUSTRY.

While this branch of concrete work is practically unknown and is believed by many to be impracticable, it is not only practicable, but can be made a great success. The results equal those produced with the expensive grades of rock usually employed for this class of work.

In the manufacture of a spire monument the use of white Portland cement, with white sand for the outside finish, gives a finished product that it is hard to surpass in beauty and artistic appearance. This same material, used with coarser sand, and the addition of coloring material, sufficient to give a slight gray tint to the work, will produce a spire of exceptional excellence, very much like a gray granite, with "tooled" face.

With the use of small particles of crushed granite, such as are wasted every year in quarries and yards, as the main aggregate, and with a properly colored cement, many excellent effects can be produced that will command a good price when placed on the market.

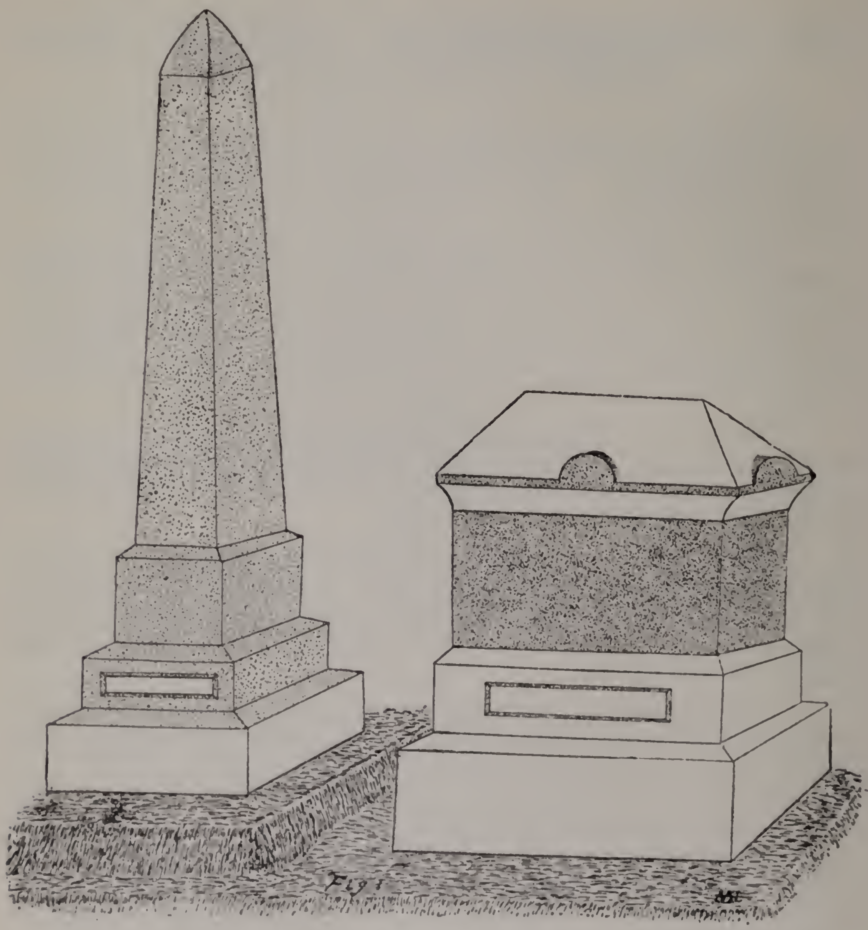
For the "die" in the block monument illustrated in Fig. 1, the use of a black or dark-colored mortar is suggested. If in this a large proportion of crushed granite, or any rock of a quartz formation is mixed, such as can be secured in many of our common stones, something that will give a pleasing effect will be produced.

A little judgment in combining different shades or colors in the different blocks or parts of the work, so as to make a contrast that separates them, without losing the harmony of shade, is necessary to produce the best work. For instance, in making the "die" with black mortar the aggregate should be of a neutral tint and the other blocks should blend in color to the top and bottom, with a lighter shade. This will produce the best and most striking effect, far more pleasing than if one block were a very deep black and the other a pure white. This can be easily accomplished by coloring the mortar, varying the amount of color in it as each new block is molded.

MANY SHADES AVAILABLE.

To produce different effects, the worker has at his command a large number of shades, from the lightest gray to the deepest black, as well as a very light or a dark red. These, with an aggregate of the same shade, produce excellent results. There is also a dark blue shade, like that of Vermont marble, as well as a medium brown, similar to the so-called "Tennessee" marble. While the two last produce very fair results, the work in these colors is not popular enough to warrant using them largely, except to order.

With the wide range of shades available for excellent effects, the concrete worker may from a very few molds manufacture a number of monuments, different in coloring, to satisfy the taste of various customers. Moreover, by combining a different top with the one "die" and bases, he can turn out a number of different designs with but slight expense for the molds.



CONCRETE BETTER THAN STONE.

Another advantage of concrete is the ease in handling the material and completing the order. While the dealer in stone monumental work must wait for his material to come from the quarry, paying freight charges and cartage, besides expending a large amount of labor in setting up the job, the concrete worker can quickly place his material on the ground, at slight cost, and the entire job can be completed in a week's time at the most. Not only is there a great saving in time and labor, but also in the first cost of the work. This should enable the concrete worker to compete successfully in price with the regular dealer, since he can erect the completed job for less

than the stone dealer would have to pay for the rock alone, unfinished. And, as price always weighs with the buying public, there cannot help but be a successful future for the concrete monument industry.

HOW TO MOLD THE LOWER BLOCKS.

In building the forms for the large spire illustrated in Fig. 1, there are given dimensions for the common size. These may be changed as desired.

For the base of Sec. A, in Fig. 2, build a box 4′ square, inside, and 16″ high. Strengthen with cleats as illustrated in Fig. 2, to which are fastened hinges at three corners, the fourth to be held together, when in use, with a hook or clasp. To form the bevel on top of this section, first plane the top of section down to a bevel, with the highest point on the inside. If one-inch lumber is used, it will require planing the outside edge down one-half inch, to secure the proper pitch to the roof of this section. To the top of the section, for the roof, cut two boards, 4′ 2″ long and 8⅜″ wide, and two boards of same width, exactly 4′ long. Plane down the edges of these boards to form a bevel of one-half inch deep, with the highest points on opposite edges. Mitre these boards at each end so that they will fit together with a tight joint, and with the 4′ 2″ boards lapping over the 4′ boards, the width of same; nail to the top of section as illustrated in Fig. 2. The mitred corners are not fastened together; so the form can be folded back from completed work, without danger of damaging it.

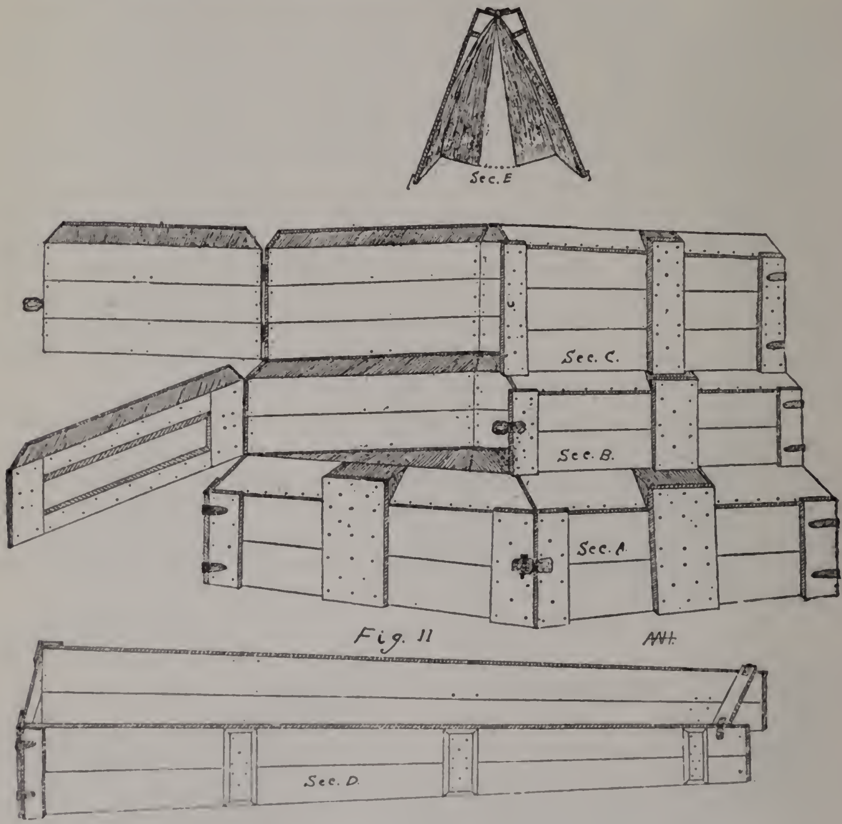
To hold this beveled roof of section rigidly in place cut four boards, 19″ long, and nail in the center of the section, as illustrated in Fig. 2, one on each side; this length allows them to extend up 3″, or level with the top of the roof of section. In the triangular space, between this board and the roof of section, fit a block to fill the space, nailing it securely to upright and to roof of section. This will hold the section securely in place and support the sections placed on top of it when molding work.

For Sec. B, in Fig. 2, make a box 3′ square and 12″ high, fasten together at corners, as in Sec. A, and make the roof or beveled top in the same manner, using boards 8⅜″ wide and cut 3′ 2″ and 3′ long, with edges overlapping as before, in Sec. A. If this block is to bear a plate for a name it will be necessary to form a panel on one side. This is made by cutting two boards 6″ wide and 12″ long, and two strips 3″ wide and 2′ long; the long strips are nailed at each side of the side of section, where the panel is to be molded, with the short 6″ strips on ends of the panel, as illustrated in Fig. 2, Sec. B. If one-inch lumber is used, this will give a name-plate 2′x6″ and 1″ deep, which may be beveled if desired by nailing beveled strips in its corners. This name-plate may be arranged for in the same manner on any section or any part of section. This arrangement provides for the name to be cut in the panel, but if it is desired to cast the name in the concrete, use letters like those for imprinting sidewalk work. Set them into this space and the name will be cast direct upon the section when the block is molded. To show up properly, the letters should be at least 4″ high.

For Sec. C, Fig. 2, build the box form 2′ square and 18″ high, fasten at corners as you have the other sections, and for the roof or beveled top use boards 5″ wide, with the same bevels and mitres in proportion as you

have in previously built sections. This will make the top of this section "draw in" but 3″ at the top, and will require the side strips used to hold roof in place to be cut 20″ long, but otherwise to be constructed in the same manner as the two other sections.

This completes the three sections, A, B and C, in Fig. 2. These are used by setting Sec. A on the foundation and filling it with the concrete mixture; Sec. B is then set upon this and filled, and Sec. C in the same manner; this completes the lower blocks of spire.



MOLDING THE SPIRE.

For the spire, which is molded upon the ground and then erected in place, make the two sides of form 6′ 6″ long, with a width at bottom of 18″, tapering to 10″ at the top, as illustrated in Sec. D, Fig. 2. At the bottom end an end form is built, 18″ square, and hinged to the two sides. The top end is left open so as to allow the form for the pointed cap to set up against it. It is held to the latter with hooks, when molding work. The sides of this form are braced with cleats, as shown in Sec. D, and at the end a cleat is hinged to one side and fastened with a hook at opposite end, to hold the two sides in place. This cleat should be 12″ long and fastened to the top of the sides. If any danger is feared of the sides

spreading, other cleats may be fastened in the same manner down the sides of the form. This form is to be set upon a pallet when molding the spire, and as a further preventive against the form spreading, small blocks should be nailed to the pallet along the sides of the form, so as to hold the form securely in position.

For the pointed cap on top of spire, illustrated in Sec. E, Fig. 2, cut two boards 10″ wide and 16″ long. Cut these so they taper on each side to a 4″ width at the top. Now cut two boards 6″ wide at bottom, 16″ long, and so they taper on one side only, to a 3″ width at top. Cut two small pieces 3″x5″ for the tops of this section. Nail the 6″ tapering strips to the sides of the 10″ strips, with the 3″x5″ pieces on top, making two sections of the same dimensions, which are hinged together at top, as illustrated in Fig. 2. The inside measurements of this section will thus be 10″ square at bottom and 4″ square at the top, with a length of 16″ inside.

Now cut three pieces of tin 10″ wide at the bottom and tapering to a point at the top; cut one of these tin strips in the center. Nail the tins that are 10″ wide at bottom to the sides of the form, as illustrated in Fig. 2, with the pointed end in the center of the top; place the 5″ tins in the bottom of form so the three sides meet in a point, in the center of top, as illustrated. To hold these tins in place, fasten several small blocks of wood between them and the outside of section, so that they will not bend out when the weight of the concrete is placed against them.

This section is fastened with hooks to the main part of the spire section or Sec. D, when molding spire. By this method of joining, it can be unhooked and folded back from the completed work without injuring it in the least. This insures the molding of a perfect spire, if the joints are made so as to fit tightly together.

FOUR-PIECE BLOCK MONUMENT.

Molds for the four-piece block monument are made as follows: For Sec. A, Fig. 3, or the base block, build a box 5′ in length, 3′ wide and 18″ high, inside measurements. Hinge it at three corners, with a hook or clasp fastener at the fourth. For the beveled roof use lumber 8⅜″ wide. This is mitred, beveled and fastened to section, in the same manner as for the base section for spire monument, or as illustrated in Fig. 3, the ends overlapping the side pieces to make a tight joint.

For Sec. B, Fig. 3, build the box 4′ long, 2′ wide and 15″ high, fastened together like the former sections. For the roof, or beveled top, use 5″ lumber, fastened as in former sections and with the same mitre cuts as in Sec. C, Fig. 2. These two sections are the same as those given for the spire, except in the general dimensions. This form of construction, giving the best method of handling forms with the greatest strength, is simple enough so that anyone can easily build the monument.

For Sec. C, Fig. 3, or the "die" form, make a box 18″ wide, 3′ 6″ long and 25″ high, inside measurements. As illustrated, this is a simple form and does not "draw in" at the top, as the top design is set upon it. In molding this block care must be used to have it perfectly level, so as to give a good joint between the "die" and the top design.

For Sec. D, or the top design, build a box 4′ 2″ long, 26″ wide and 14″ high, inside. This is nailed securely together at all four corners. Now take four boards, 12″ long and 8″ wide, and from them cut a 9″ half-circle in the center of one side; this will make a half-circle 9″ wide and 4½″ deep. On the edge from which the half-circle is cut, draw a line 3″ from edge, plane off this 3″ space to a point at edge of board. Nail these on the inside of the box form, exactly in the center of each side and end and 2″ below the top of the box form. Now take four boards, 12″ long and 4″ wide, on one edge. From the center of each cut out a half-circle 1½″ deep and 3″ across; plane a bevel on the top edge of each 1¾″ wide, and nail to the larger circle boards, the top even with the beginning of bevel on them. Boards to form the oblique top are nailed to these circular forms and cut out to fit around them where they touch, as shown in Sec. D, Fig. 3. The insides of these half-circular forms are lined with tin, to make a smooth surface, the edge of the tin on the inside coming even with the edge of boards which mold the inclined top.

To cut the lumber for the oblique top, use four 2″x2″ strips, 21″ long; mitre each pair together to form a point at one end, with the other ends 26″ apart, so they will just fit into the box form, one leg in each corner of its ends. These triangular parts are the framework to which the boards are nailed to form the top, and it will be necessary to place their ends, fastened in each corner of outside form, 3″ below the top of the outside form, so that when boarded up with one-inch lumber the inclined top will begin 2″ below the top of the outside form. This forms the 2″ perpendicular strip around the top, illustrated in Fig. 1. While the ends of the inclined surface may be boarded up on the 2″x2″ strips, it will be necessary to nail a cleat on the outside edges of these strips, to project enough to allow the sides, forming the inclined surface of top, to be nailed to them. In this way the mold will be smooth on the inside or molding surface, and better joints can be made, insuring better finished work.

To form the concave "swell" to the bottom of top design, where it sets on the "die," cut two boards 6″ wide and 4′ 2″ long, and two of the same width, 26″ long. Now cut the same number of boards 4″ wide, and the same length as the above four; nail these to the 6″ boards at right angles, the 6″ boards overlapping the 4″. In this space nail molding to form a quarter-round to each piece, and then cut a square mitre on each end so they will fold together perfectly. The 4′ 2″ parts are hinged to the sides and the 26″ parts are hinged to the ends of Sec. D. This is illustrated in Fig. 3, with one end and side in position for molding, and the others folded back. After top design is molded, these quarter-round pieces are folded back, and then, by simply turning the mold over, the top "die" is removed easily. The quarter-round pieces at top can be made all in one piece of the dimensions given if desired.

The top design is molded in one piece, face-down. This brings all the trowel finish on the bottom, or the part that sets onto the "die," so that the oblique surface of top will always be perfectly formed.

SUGGESTIONS FOR HANDLING MOLDS.

Before using molds it is best to apply at least two or three good even coats of shellac to them, on the inside, so as to give a smooth molding

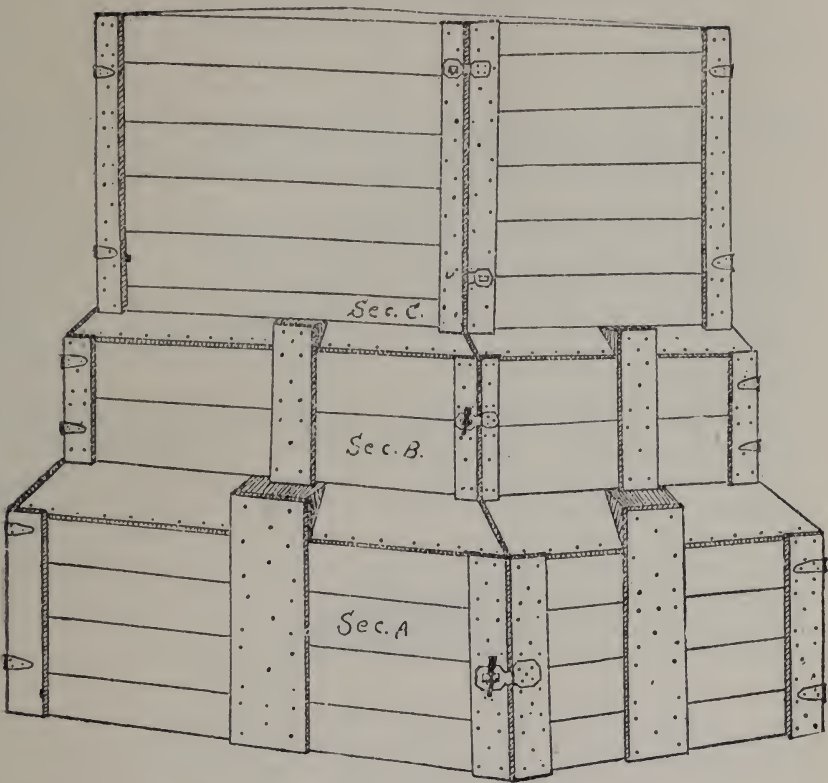
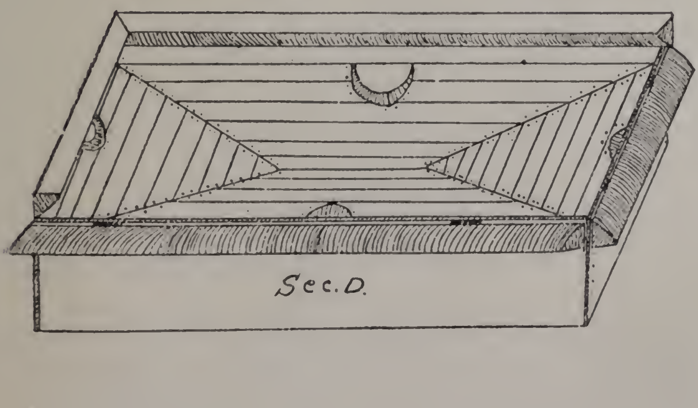


Fig. 111



surface. Care must be taken that all cracks, however small, are filled with the shellac, and the surface perfectly even and smooth. By renewing this coating as often as necessary, as good work can be produced as with a metal mold for the results desired in this business.

The shellac coating is advised, as it has been found to be a success. While the molds may be lined on the inside with tin, where there are joined together the joint is always sure to leave a mark in the completed work.

It is also found that the best results are obtained with a rather wet mixture of concrete, so that it may be more easily packed into the molds and made to fill each corner full and perfectly. A saving of material may be secured by having the concrete mixture for the outside of the work of a very rich consistency, using finely-screened sand. Have this of the right consistency so that it may be plastered on the inside of each section, as it is molded, to the depth of several inches, and the center of the mold filled with a coarser mixture. This requires more time and labor in doing the work, but the results obtained justify it. The outside surface is smoother and perfect, and in using this method you have only to color the mortar for the outside coat.

A number of other valuable ideas and methods will suggest themselves to the worker in addition to the more important ones briefly outlined.

THE USE OF GLUE AND WASTE MOLDS FOR ORNAMENTAL CONCRETE WORK.

Owners and architects frequently desire to give a building a decorative, ornamental front, in order to get away from the monotony of commercial architecture, but often find that in adding a few ornamentations in stone-molding or carvings, the cost is increased to a prohibitive point, and the building is built like all the rest. On the other hand, it is possible to increase the value of a building to the extent of ten per cent of the total cost, in some cases and localities, by using ornamental artstone trimmings, thus giving the building an artistic appearance and form. Little extra expense is encountered by substitution of art for plain, natural stone produced by hand-cutting, and for this reason the manufacture of artstone is of importance to the development of architecture and design in residences, terraces, apartment buildings, etc., where the owners cannot afford hand-carving. Concrete solves this problem perfectly. Sometimes the stone-cutter is in doubt about the quarry from which the stones for trimming are shipped. With experience and proper treatment, artstone can be made to resemble natural stone so closely that only the structural grain discloses the difference on close observation.

For any ornamentation, such as a name-plate, ornamental panel, brackets, ornamental head or key of an arch, etc., a full-size detail should be furnished by the architect. From this is made a clay model in the shape of the stone to be designed and shown on the outside wall-space, which is generally modeled about an inch thick. The actual stone thickness for the part in the wall is more easily made by a separate wood frame.

Making this original clay model is the only part which general practical mechanics or "jacks of all trades," cement molders and cement workers, cannot do without some years of training and study of forms. In most cases it takes an artist of ability. The writer has, however, observed some men who could in a very short time produce good pieces of ornamentation, after very few instructions and practical experiments. The clay models, nevertheless, can be easily and cheaply purchased or made from drawings by most ornamental stonecutters, woodcarvers or ornamental ironworkers in almost any locality.

After the clay model is finished, almost any practical, intelligent laborer can produce the necessary waste or glue mold, and from that the concrete cast, by observing closely the principles of the mold system.

The illustrations, Figures 1 to 11, give the principles of methods generally required for reproducing all kinds of building ornament, and based on these examples the glue mold and the waste mold process may be used.

The glue mold may be used to the best advantage where several casts

Fig. 1.

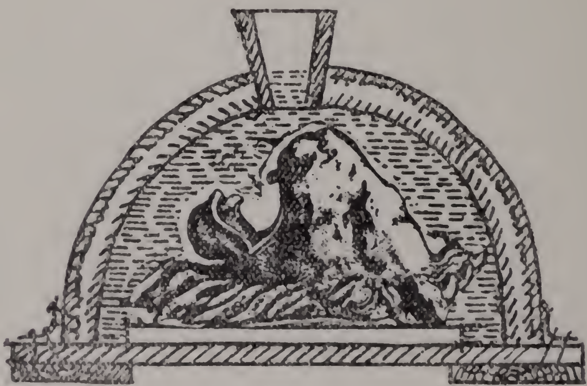


Fig. 2.

from the same mold are required; the waste mold is better for a single reproduction of a clay model.

Figures 1 to 3 show a glue mold process for casting several reproductions (as shown by Figure 1) of a stone without the wall thickness of the clay model with a pallet, since the modeler should furnish same.

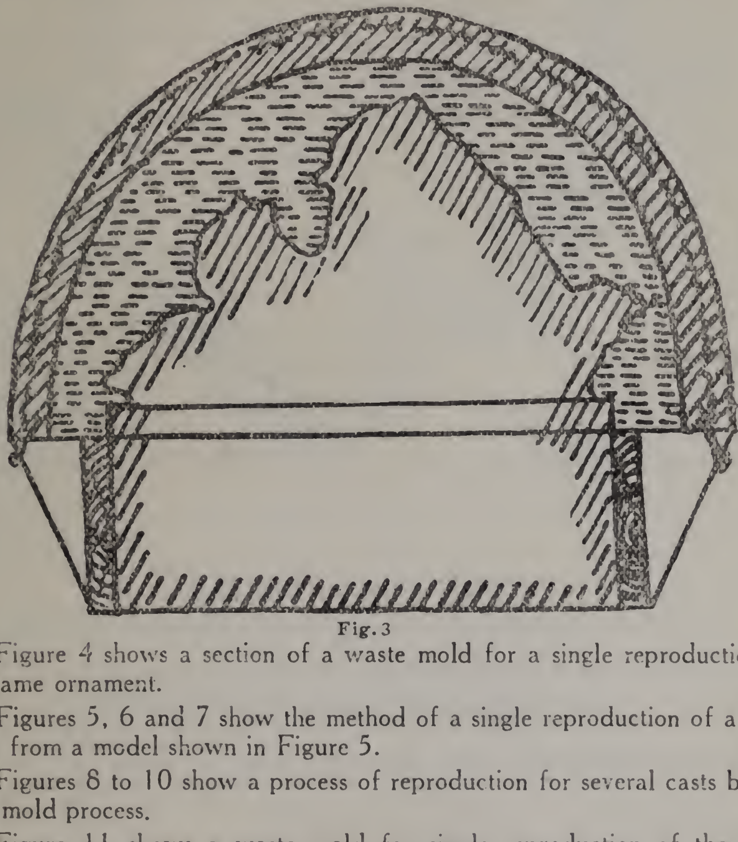


Fig. 3

Figure 4 shows a section of a waste mold for a single reproduction of the same ornament.

Figures 5, 6 and 7 show the method of a single reproduction of a sign-plate from a model shown in Figure 5.

Figures 8 to 10 show a process of reproduction for several casts by the glue mold process.

Figure 11 shows a waste mold for single reproduction of the same ornament.

Whether to take the glue mold or the waste mold process depends on the number of casts required from the clay model direct. Sometimes, especially with complicated, expensive pieces, it is advisable to take from the clay model a waste cap and fill this with plaster, transferring the model to a plaster cast, and use this hollow cast plaster model for making the glue mold, as by the glue mold process there is some insurance against the loss of the original clay mold.

For making an ornamental name-plate, as shown in Figure 5, first form the wall space with a layer of clay as stiff as painter's putty, of fine, well-mixed blue clay, spread out evenly, about one inch thick, using guides in form of strips all around, one inch thick, and produce chisel mark imitations on the surface with a corrugated knife or strip of iron. Then form the letters of clay or wood (they should always be a little conic, so as to draw well) and add other ornamentations or moldings, either of specially

molded plaster moldings, plain or carved, or of plain or carved wood molding. For further decoration inside the space or about it, special plaster casts or stock size pressed tin ornamentation may be used, to conform strictly to the design, or with slight variation only. In the latter case, the designer should always be consulted, as frequently much trouble arises from this score. Sometimes the stock moldings described may be used to great advantage, when the architect finds no objection to their use and they are in conformity with the desired stye.

After the model is completed, paint it with a thin coat of talc dissolved in hot petroleum, first pouring thinly mixed plaster of paris over the entire surface, letting the plaster fall in a fine, thin stream, in order to avoid air-holes. Then mix the plaster thin and let it stand until it gets like mortar before applying it. Always spread the plaster out in even layers over the model. Pieces over two feet in any direction should be reinforced with burlap, cord, linen or pieces of wood. The thickness of the waste cap varies from one to three inches. The reinforcing is of importance, as the plaster shell is liable to warp and bend in removing and handling.

After the shell is hard, take out the clay model, which is destroyed, wash the shell out with a hose and water pressure and brush, when necessary. Then give the inside a coat of grease and build a frame on the top to correspond with the required wall thickness. This frame is secured in position by a brace, as shown in Figures 7, 10 and 11. After the stone is filled by either the dry tamping and veneering or wet process, the shell is easily broken from the cast with a hammer and chisel.

For making a glue mold of a model, as shown in Figures 3 and 9, cover the model first with wet newspapers; then cover it carefully with plates of soft clay, from one to three inches in thickness, according to size. Now smooth the surface carefully, so as to form a layer of even thickness. Build over this a plaster cap in the way described for waste molds. The clay layer should always be applied so that the cap may be removed without disturbing the clay layer. Leave opening on top for filling in with glue, as shown in Figures 3 to 9. After this plaster cap has hardened, remove it carefully, and also the clay plates from the model, which now forms the space for glue between the plaster cap and the model.

After the model has received a coat of grease, set the cap into the same position as before and fasten it securely to the pallet, as shown by Figures 2 to 9. It is advisable to paste the cap with plaster and a piece of burlap into the angle of the pallet and secure it by nails to the latter. The security of joints and freedom from cracks in the pallet is of importance, as an enormous pressure is produced as soon as the mold is filled with glue and begins to cool. When the mold bursts or is lifted off the pallet, the glue is lost and frequently the model is damaged.

Before pouring the glue, be sure that small holes are drilled into all parts of the cap, which may form an air-pocket, and into all parts from which the air cannot escape in the slow filling of glue; as soon as the glue appears at the air-escapes, fill them securely with clay.

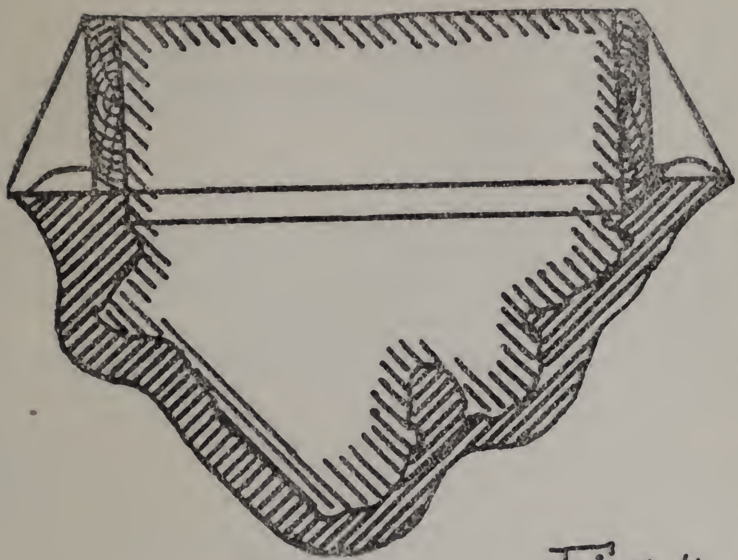


Fig. 4.

Fig. 5.

SUGGESTIONS FOR MATERIAL.

It is best to use the best kind of dry glue, in form of plates. For testing its quality, the glue is put into cold water for about twenty-four hours. A good glue, after this time, should be in complete swollen plates which do not break or dissolve or crumble. In case the glue is adulterated with chalk, etc., to increase its weight, the plates dissolve and take up little water, while good glue will sometimes take from five to six times its weight when submerged in water. It is advisable to weigh glue dry, and then after it has been soaked in water its quality may be determined.

A further test of glue may be made by glueing two pieces of board together and breaking them. In case the joint parts without breaking the wood near the joint, the glue is not the best and will easily rot after it has been dissolved several times and used for molds.

For concrete casts, it is best to dissolve the glue in a pot hanging in another pot filled with water. The water is kept boiling, which dissolves and keeps the glue a little below the boiling point and protects it from burning. Dissolve the glue while hot, by adding water to it until the mixture is of the consistency of thick coal-tar or syrup. Then pour the hot glue in a fine stream into the mold, allowing the air to escape through the air-holes and also through the opening for filling.

Sometimes it is desirable to have the glue elastic, as when the model has deep and sharp undercuts. To regulate the elasticity, or to overcome brittleness, mix for trial a small quantity of glue with a very small percentage of glycerine and sugar syrup, mixed half and half, to find the proportion before using the same proportion for the whole amount of glue.

After the glue is poured the mold should be kept in a cool place for a day, and sometimes for two days or longer. The glue in this state will spoil if kept below the freezing point, or in places where it is warm and damp or where the sun shines on it for several hours.

When the glue has attained the consistency of soft rubber, take off the plaster cap and the glue shell, which may be divided by a knife into sections, as may be necessary to overcome undercuts. The glue shell and all pieces should be placed immediately into their position in the plaster cap on removing them from the model or cast, as the glue shell is easily deformed.

Then paint the inside of the glue shell carefully with a coat of linseed oil and white lead; after a day with a coat of grease, and the mold is ready to receive the cement or plaster cast.

It is always advisable to produce a plaster cast first, as the clay model and glue may be damaged by accident or carelessness.

CARE IN SELECTING CEMENT.

For casting stone with wall thickness, set a frame on top of the glue opening, as shown in Figures 3 and 10.

For casting concrete in glue molds, the glue should be greased and cleaned off after each cast. The cast remains in the mold from two to six days, according to the temperature and the setting qualities of the cement.

On account of the present limited use of cement for the purpose of casting ornamental concrete work, and also ornamental plastering, the

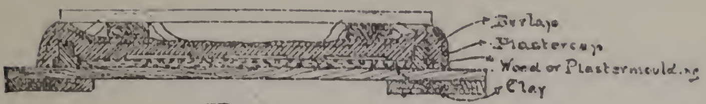


Fig. 6.

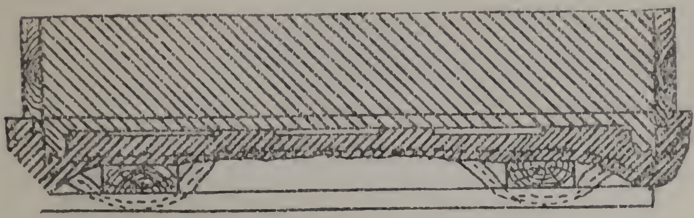


Fig. 7

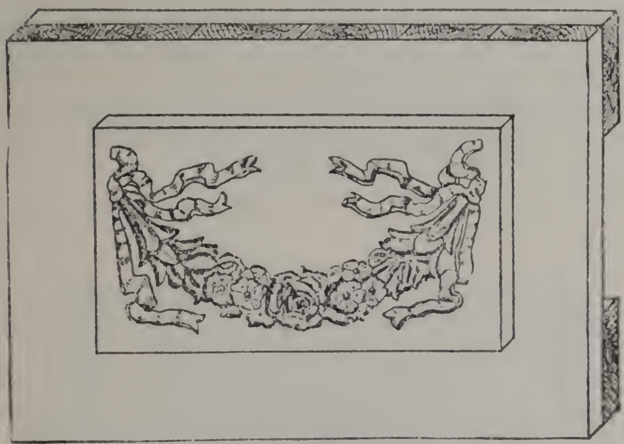


Fig. 8.

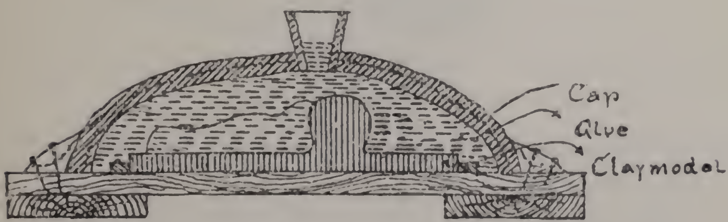


Fig. 9.

American cement manufacturers have not yet taken up the manufacture of different grades as to setting (without interfering with the quality, color, final hardening and price of the cement) without any injury to the product.

The development and increased production of ornamentation for all kinds of purposes depend on two points alone. The universal success of ornamental art-stone work in its highest development in Germany, France and Belgium, was and is possible only through the use of quick-setting cement, like plaster. Nearly all European manufacturers make four kinds, as to final time of setting, this matter being regulated in the process of burning:

1. Slow-setting cement, finally hardening in three to four hours. (These sacks are closed with gray cords, as an identification mark.) This

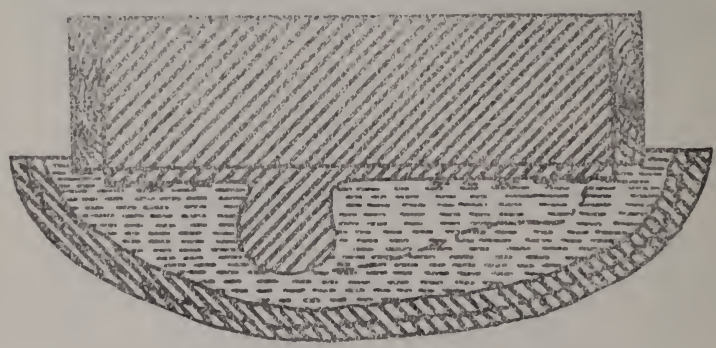


Fig. 10.

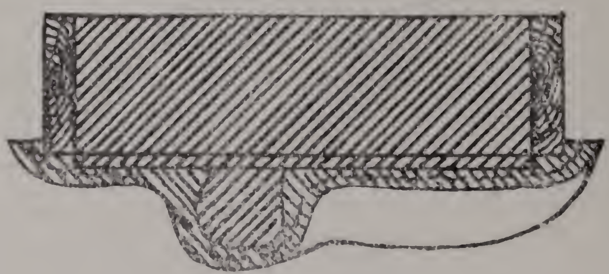


Fig. 11.

cement is used for reinforced concrete, brick and construction work, where time is of no importance.

2. Medium quick-setting, finally setting in one and one-half to two hours. (Blue cords as a mark.) Used mainly for artstone, dry tamping work, etc.

3. Quick-setting, finally setting in thirty to forty minutes. (Red cords as a mark.) Used mainly for plastering buildings outside, in the manufacture of concrete stucco moldings and work in winter time, on account of danger to concrete and brickwork from frost.

4. Very quick setting cement, finally setting in three to five minutes, generally quicker than plaster of paris when in a fresh state. (White cords as a mark.) Used exclusively for ornamental artstone work. Is mixed dry with fine sand, then water is added and it is filled in while in a thin state as quickly as possible before it hardens.

The use and manufacture of cement No. 4 is of the utmost importance to the American cement and concrete industry. As soon as a cement of this kind can be obtained for the purpose, the American production in ornamental work and art will overshadow all previous accomplishments.

The main advantage of a cement of this kind is that the glue or plaster piece may be removed almost immediately after the thin concrete is poured, and be used twelve or more times a day; on the other hand, if in using the uniform standard cement, a single cast has to remain a few days in the mold, the dampness destroys the glue and only one or two, sometimes three, casts which are fairly perfect may be made. After the glue of the mold has stood nearly continuously between the wet concrete and damp plaster shell, the glue gets soft and stringy and needs reboiling under the same process as described above.

It is possible to work with the slow cement but retouching cannot be done so easily as with the quick-setting cement, whereby the seams and imperfections may be removed easily, as the cement is generally as hard as soap for several hours and cuts readily with a knife, before it finally hardens. It will, however, not be very long before this kind of cement is on the domestic market in this country. It cannot be imported very well, because its quick-setting qualities are lost in a few weeks' time during transportation. It becomes slower and medium quick-setting with increasing age, but it can be kept in a hot storage house in large quantities for a long time without losing its characteristics.

POINTS ON THE ART OF MOLDING ORNAMENTAL CONCRETE WORK.

Everyone engaged in the concrete industry is at one time or another called upon to do some kind of ornamental concrete work or to give instructions on how to proceed. Many times this problem is solved with more or less success, but in some cases something is called for to be made in a special design, and frequently natural stone is substituted where, at less cost, the most beautiful art work could be produced in concrete itself. For this reason, the writer will try to give some information from his past experience in this line, and show the best of many ways to secure excellent results.

The writer is well aware of the difficulty to be overcome by men engaged in this line, who have a one-sided experience, that of the necessity for choosing in each special case work according to drawing; work which cannot be turned out in standard iron machines, without heavy expense, in order to conform to the architect's design.

In order to have success in this line one should have in the first place a full sized detail or section drawing. He must be able to line out from this the design of the mold. He should be able to draw details and when these requirements are combined with a general experience in concrete and its nature and practical instructions—success is assured. The art of making the original model must of course remain part of the work of the specially trained artist, the sculptor, but the matter of making the molds and the casts is a mere mechanical part which any good mechanic, handy with tools, can easily accomplish.

The methods of molding by which concrete is given artistic form may be divided as follows:

1. Stationary wooden or iron molds for reinforced construction, etc.

2. Portable and stationary molds and machines for the manufacture of standard commercial products.

3. Wood and plaster molds, transportable, for straight, profile or curved stones, used in small quantities to fill the requirements of special design.

4. Plaster of paris molds, transportable, for a single reproduction of a model or ornament.

5. Plaster piece molds, used for frequent reproduction of ornamental work with large details on a large scale where, by means of seams, the pieces can easily be retouched without destroying the detail.

6. Glue molds, for frequent reproduction of art work having small details, or large details with deep undercuts.

7. Plaster, wax molds and glue molds in connection with monolithic construction.

8. Molding by the foundry process with a slight variation.

PROCESSES AND METHODS.

The first two processes are generally known and the description of them would fill a small library, therefore the third mentioned process will be taken up first.

Wood molds are used to advantage in a case where the special stone, plain, with profile or curve, is used in limited quantity, or when it cannot be made on a standard machine without heavy expense. In order to construct a wooden mold for this purpose, have a full size section, or drawing and draw on this the parts of the mold, using standard thickness of lumber and divide the negative parts in such a way that each piece will "draw" after having been filled and tamped by the dry tamping and veneering process.

In nearly all cases it is most practical and advisable to design the mold so that the front of the stone lies at the bottom of the mold. In this way the filling side will naturally come into the wall. All that is required in this case is turning over, either on a sand bed or sand pallet according to the dimensions of the stone.

For holding the mold together while tamping and turning, wooden or iron clamps are used, which hold the mold together either by wedges or screws, according to the number of stones required.

All parts inside of the wood mold should be sandpapered and have from one to three coats of shellac, the number of coats being governed by the number of stones to be made. One good coat will allow from three to four casts at one time, without sticking. Three coats will allow continuous operation, provided the mixture is not made too wet. Its consistency should be about the same as is used in iron machines for block. For wood, it is always good to use yellow pine having plenty of pitch; such wood will not warp very much, nor will it take up water easily.

PLASTER OF PARIS FOR SMALL PARTS.

In case a stone has a curve or a curved profile or a combination which is difficult to produce in wood in the negative shape, such parts are easily made of plaster of paris. They are generally drawn on a table, having as a guiding line either the straight line, centerpoint or curved pattern. The pieces thus made are sawed and fitted into the wood mold and are coated with shellac and sandpapered. The mold is filled in the veneering dry tamping process.

Plaster pieces used for the dry tamping process should have no sharp angles or sharp undercuts. Where wood in this process would draw easily plaster pieces are sometimes hard to remove. A slight coat of talc dissolved in petroleum will help in most cases.

By this process almost any kind of plain or profile stone can be produced for special purposes. A carefully made mold can sometimes produce a hundred or two good casts. The main point in this mold construction is that the negative parts are so arranged that they can be

removed one by one, without disturbing the cast or the other parts of the negative.

WAX MOLDS.

These are used to the best advantage when only a single cast or ornament is needed for a job, such as a sign or name-plate or a keystone for an arch. The process differs from the others. In order to have complete success with it, a full size elevation drawing is necessary and should always be furnished by the architect.

This drawing is given to the sculptor or artist, who models the ornament in clay on a smooth board, but only that part which is shown outside of the wall. If wall space is present in the ornament, it is advisable to make it about one inch thick. The finished clay model, with plate for wall space is given one coat of talc dissolved in hot petroleum and then covered with thin mixed plaster of paris. The thickness of the shell is governed by the size of model and ordinarily varies from one to three inches.

Pieces over two feet in any dimension should always be reinforced with either burlap, cord or linen and some sticks, in such a way that the shell cannot possibly warp under the later treatment. After the plaster shell is thoroughly hardened it is taken from the board with the clay. After the greater part of clay is removed, use a hose with strong water pressure on the negative. All defects and air holes in the shell should be carefully corrected either with plaster or clay. Then give the inside of the shell a light coat of grease and build a frame on top of the negative to conform to the required wall thickness of the stone. It is advisable to provide on the positive model strips, so arranged that the frame engages with them and is so held firmly in position for filling. This may be done either by the dry tamping and veneering process or the wet process. In either case, the cast has to remain from one to two weeks in the shell, according to undercuts, etc., but in some cases, where there are no undercuts, the shell may be removed immediately by the dry process. At the proper time the shell is broken off the cast with a hammer and chisel and cleaned off with water.

THE VENEERING PROCESS.

Where the stone has small details and a smooth surface is desired, the dry process should be avoided. By the following process perfect casts can be secured: Pour into the slightly greased mold a syrup-thick mixture of clear Portland cement; spread this carefully out over the entire surface of the negative, without filling it up too deep; then take an earth-moist mixture of three parts of fine sand and one part cement and press it into balls which are pressed tight into the veneering and uneven spaces; the object of this process is to avoid air-holes which will always occur with other systems.

Another point of importance and interest is that clear Portland cement used in any other way will very soon show air-cracks, which are absolutely avoided by this method. After an even layer of about two inches in thickness has been applied and well pressed and tamped, fill up the mold with a common coarse mixture, about half wet, so as to have no surplus water; tamp it thoroughly and smooth it over. After one or two weeks the shell is easily broken off and the stone will have a perfect surface and even color.

PLASTER PIECE MOLDS.

This process is used in cases of ornamental designs which can be filled by tamping and which are of such form as to allow the immediate removal of the parts of the mold.

In case less than five casts of such a design are required, it is advisable for economic reasons to resort to the later described glue mold process. A good plaster piece mold well arranged and prepared will furnish from 20 to 40 perfect pieces, but very seldom more than 40. The number of perfect pieces depends on the size of pieces, number of sharp edges, etc. After a certain number has been made the edges get soft and round; pieces do not fit tight and it is necessary to provide a second mold. The general advantage of this process over the glue mold is in the length of time required for the production with a single model by the latter.

Piece molds of small objects having large details can be made direct from the clay model, but for more complicated designs and with less experienced labor it is always advisable to produce first either by the described mold process or by the later explained glue mold process. The shell of the mold is sometimes hard to remove from the plaster cast on account of its color. For this reason, give the mold in such case a distinctive color and at the same time reduce the material strength of the shell by mixing into the body of it sand, sawdust or lime.

The reason why a plaster model for making a piece mold is necessary in most cases is that the clay model is cut, and frequently damaged by cutting and fitting the different parts; besides, the clay is liable to stick in pushing the new pieces into position.

Before starting the piece mold, the model should be fastened securely with nails or wire to a pallet, the latter being about six to eight inches bigger all around than the model.

Place the model on the pallet on that side from which the mold is to be filled. First give the plaster model a good coat of shellac, then a light coat of grease. In using the clay model direct, give it a coat of grease only.

Start at the bottom of the model to build blocks of plaster in such form that the pieces can be removed; insert at the back of each piece a wire hook by which it can be taken off by means of another hook, without interfering with the model or other pieces.

When one piece is set and sufficiently hard, take it off by inserting a hook in the center and cut it off even with a knife, a saw or a plane. In this way two sides of the cube are formed even, one side is formed by the model and the remaining three are to be cut flush. Always put a thin coat of grease on the sides of the pieces already made, which form part of a mold for the next piece; continue the process until the whole of the model is covered and forms a tapering object, of such shape that it would slip out if covered with a plaster cover. Take off all extensions with knife or plane and smooth the whole outside thoroughly. All openings for the wire hooks in the pieces are pasted up with clay. Then each piece is given a number with an indelible pencil and the whole given a coat of grease, which is then covered with a cap, reinforced with burlap, wire and wood, from one to four inches thick, according to size. After the cap is hardened, it is taken off easily, provided that all openings have been carefully filled up with clay.

The marks of the indelible pencil now show a reverse picture of the running numbers, and the marks on the pieces indicate their position. It is, however, advisable to re-mark with the pencil each number, as it saves considerable time in future processes.

In taking off each piece, any air-hole or defect should be repaired, and the working side of each piece should receive from one to three coats of thin shellac in alcohol, according to the number of casts required. Each piece should also be painted with shellac, at least one-half inch around the joint which comes in contact with the concrete. Before filling by the dry process a thin coat of grease is advisable. A mold of this kind should be removed immediately after the filling, or if the undercuts do not allow the immediate removal, leave the cast in a day or two.

CEMENT MADE IN GERMANY.

In European countries, the cement manufacturers have for the last twenty years made a special cement for this purpose which allows the use of a very wet process. The cement is poured very thin in the mold, in the way described, and after about five minutes the cast can be removed; it is as hard as wax and the seams may be cut like butter. In this way, the molding process is less hard on the mold.

GLUE MOLDS.

Glue molds are used to advantage in all cases where several casts are required. After the clay model is finished, cover it with wet, soft newspaper or something similar, and put around the model clay plates from 1 to 3 inches thick. Smooth the outer surface and build over the clay veneer a plaster cap in such a way that it can be taken apart without disturbing the model.

The plaster cover should always be reinforced. After it hardens, remove the cover and the clay veneer and paper from the model; give the model a coat of grease and set the cover again in the same place, after a two- or three-inch opening for pouring glue has been provided and small openings drilled every half-inch where air-pockets could form. The mold should always be fastened on its bottom and sides with nails, plaster or other support, as the glue pressure is enormous.

FILLING THE MOLDS.

Fill in the hot glue, dissolved to the thickness of syrup, running it in a fine stream. After remaining a day, or sometimes two days, according to temperature, take off the plaster shell and set it up and fasten it together again; then take off the glue shell from the clay model and slip same into the plaster shell. In case the glue shell should not come off on account of deep undercuts, cut the glue shell in such a way as seems most practical, and set the pieces into the plaster shell. The inside generally receives a good coat of linseed oil and white lead; after a day, put on a light coat of grease and fill in the cast in the same way as described in the wet process above.

It is always advisable to mold first a plaster model, with its sides from ½" to 2" thick. By molding a plaster model first, there is some insurance against the loss of the clay model and damage to the glue mold.

If common slow-setting cement is used, the glue shell will furnish about three or four good casts in cool weather, in hot weather a smaller number, in about eight or ten days. On the other hand, by using a quick-setting cement, spoken of under piece molds, a glue mold in cool weather will furnish about a dozen good casts by the wet pouring process in a single day.

In warm weather, it is necessary to give the glue a light coat of linseed oil with a little white lead, each time the mold is used.

COST DATA, CONCRETE BLOCK

In a paper read before the N. A. C. U. at Cleveland, Ohio, January, 1909, J. Augustine Smith, of the Ideal Concrete Machinery Co., South Bend, Ind., presented a number of interesting figures on the cost of manufacture of concrete block. These are given below:

Proportions of 1:3:4. Facing ½″ thick of 1 cement, 2 sand. One hundred 8″x8″x16″ block require:

1.05 yds. gravel, at	$1.00	$1.05
.79 yds. sand at	1.00	.79
2.02 bbls. cement, at	1.50	3.04
Labor, at	.02¾c per blk.	2.75
		$7.63

One hundred 8″x10″x16″ block require:

1.40 yds. gravel, at	$1.00	$1.40
1.06 yds. sand, at	1.00	1.06
2.62 bbls. cement, at	1.50	3.94
Labor, at	.03c per blk.	3.00
		$9.40

One hundred 8″x12″x16″ block require:

1.68 yds. gravel, at	$1.00	$1.68
1.27 yds. sand, at	1.00	1.27
3.08 bbls. cement, at	1.50	4.62
Labor, at	.03¼c per blk.	3.25
		$10.82

One hundred 8″x8″x24″ block require:

1.62 yds. gravel, at	$1.00	$1.62
1.23 yds. sand, at	1.00	1.23
3.12 bbls. cement, at	1.50	4.68
Labor, at	.04c per blk.	4.00
		$11.53

One hundred 8″x10″x24″ block require:

2.02 yds. gravel, at	$1.00		$2.02
1.53 yds. sand, at	1.00		1.53
3.80 bbls. cement, at	1.50		5.70
Labor, at	.04¼c per blk.		4.25
			$13.50

One hundred 8″x12″x24″ block require:

2.43 yds. gravel, at	$1.00		$2.43
1.82 yds. sand, at	1.00		1.82
4.46 bbls. cement, at	1.50		6.70
Labor, at	.04½c per blk.		4.50
			$15.45

One hundred 8″x8″x16″ block will displace from 1333 to 1422 brick.

1333 brick laid in wall at $14.00 per M., cost . . $18.67
100 8″x8″x16″ faced block cost $7.63.
These selling at 4c profit per block $11.63
Laying in walls costs 3.00

Total cost in wall 14.63

Saving on every 100 block . . . . $ 4.04

One hundred 8″x12″x16″ block will displace from 2000 to 2133 brick.

2000 brick laid in wall at $14.00 per M., cost . . $28.00
100 8″x12″x16″ faced block cost $10.82.
Allowing 4c profit per block, cost $14.82
Laying costs 4.00

Total cost in wall 18.82

Saving on every 100 block . . . . $ 9.18

One hundred 8″x8″x24″ block will displace from 2000 to 2133 brick.

2000 brick laid in wall at $14.00 per M., cost . . $28.00
100 8″x8″x24″ block cost $11.53.
Allowing 5c profit per block, cost $16.53
Laying costs 5.00

Total cost in wall 21.53

Saving on every 100 block . . . . $ 6.47

One hundred 8″x12″x24″ block will displace from 3000 to 3200 brick.

3000 brick laid in wall at $14.00 per M., cost. .$42.00
100 8″x12″x24″ block cost $15.50.
Allowing 6c profit per block, cost......$21.50
Laying at 7c per block.............. 7.00

Total cost in wall...................... 28.50

Saving on every 100 block...............$13.50

A high grade of facing brick, costing $21.00 per thousand, will cost, laid in the wall, $48.00 per thousand. We have assumed common brick at $14.00 per thousand.

An 8″ brick wall, faced with pressed brick as above, and equivalent to 100 8″x8″x16″ block, will require:

667 pressed brick at $48.00 per M.....$32.00
667 common brick at $14.00 per M.... 9.33

Total..............................$41.33
100 8″x8″x16″ faced block laid in the wall cost 12.93

Saving on every 100 block...............$28.40

A 12″ brick wall, faced as above, and equivalent to 100 8″x12″x16″ block, will require:

667 pressed brick at $48.00 per M.....$32.00
1333 common brick at $14.00 per M... 18.66

Total..............................$50.66
100 8″x12″x16″ block laid in wall cost...... 16.55

Saving on every 100 block...............$34.11

The above figures allow 4c profit per block to the manufacturer. In a case like this the manufacturer would figure on a higher profit, as he is sure of getting the job when competing with pressed brick.

COST OF BRICK.

An 8″ brick wall, faced with pressed brick and equivalent to 100 8″x8″x24″ block, will require:

1000 pressed brick at $48.00 per M....$48.00
1000 common brick at $14.00 per M... 14.00

Total..............................$62.00
100 8″x8″x24″ block laid in the wall cost..... 19.00

Saving on every 100 block...............$43.00

These figures allow the manufacturer 5c profit per block.

A 12″ brick wall, faced with pressed brick and equivalent to 100 8″x12″x24″ block, will require:

1000 pressed brick at $48.00 per M....	$48.00
2000 common brick at $14.00 per M...	28.00
Total..............................	$76.00
100 8″x12″x24″ block laid in the wall cost....	27.65
Saving on every 100 block...............	$48.35

The above figures allow 7c per block profit to the manufacturer.

As stated above, when competing with pressed brick and cut stone, the manufacturer will usually charge a higher price for his block, as he will have a greater leeway.

The above computation on brick is figured upon the least displacement of 100 block in the wall. One thousand three hundred and thirty-three brick is figured on a basis of 22½ brick to the square foot of 12″ wall, three brick thick, or 15 brick per square foot of 8″ wall. The same is true in every other computation I have made, as I have taken the least displacement possible on which to base my figures so that the results cannot be questioned from a standpoint of favoritism to concrete block. Furthermore, all the above is based on costs shown in small-sized plants, operating with two or three men, mixing by hand, and buying materials in small quantities.

COST UNDER FAVORABLE CONDITIONS.

The labor costs include all fractional and window jamb blocks. Furthermore, the costs shown are on faced concrete block against common brick. Where pneumatic, or power tamping, is used, materials are brought in quantity and a greater number of block turned out, the cost can be cut down considerably, and will more nearly approach the following:

100—8″x8″x16″ block will require:

1.05 yds. gravel, at...........	$ .80........	$ .84
.79 yds. sand, at............	.80.........	.63
2.02 bbls. cement, at..........	1.30.........	2.63
Labor..........................		1.83
		$5.93

This assumes a reduction in labor of 33⅓ per cent. Figuring on the above basis, the other sizes will cost as follows:

100—8″x10″x16″ faced block will cost......	$ 7.46
100—8″x12″x16″ " " " "	8.55
100—8″x 8″x24″ " " " "	9.00
100—8″x10″x24″ " " " "	10.63
100—8″x12″x24″ " " " "	12.21
100—8″x8″x16″ block, with 4c profit per block, can sell at..........................	$ 9.93
Laying in wall will cost..................	3.00
	$12.93

Equivalent brick (1333) laid in wall at $14.00 per M.	$18.60
Saving on every 100 block	$ 5.67
100—8″x12″x16″ block, with 4c profit cost	$12.55
Laying costs	4.00
	$16.55
Equivalent brick (2000) laid in wall at $14.00 per M.	$28.00
Saving on every 100 block	$11.45
100—8″x8″x24″ block, with 5c profit per block cost	$..14.00
Laying costs	7.00
Total cost in wall	$19.00
Equivalent brick (2000) laid in wall at $14.00 per M.	$28.00
Saving on every 100 block	$ 9.00
100—8″x12″x24″ block, with 7c profit per block cost	$20.65
Laying costs	7.00
Total cost 100 block in wall	$27.65
Equivalent brick (3000) laid in wall at $14.00 per M.	$42.00
Saving on every 100 block	$14.35

An 8″ monolithic wall, 1:3:5, figured on a basis of $1.00 per cubic yard for gravel and sand, and $1.50 per barrel of cement, will cost about $7.12 per cubic yard, under very fair conditions.

100—8″x8″x16″ faced block cost	$ 5.93
Laying costs	3.00
Cost in wall	$ 8.93
Cost per cubic yard	4.09
Saving per cubic yard in favor of block	3.03

A 10″ monolithic wall will cost $6.52 per cubic yard.

100—8″x10″x16″ faced block cost	$ 7.46
Laying costs	3.50
Cost in the wall	$10.96
Cost per cubic yard	3.99
Saving per cubic yard in favor of block	2.53

A monolithic 12″ wall will cost $5.02 per cubic yard.

100—8″x12″x16″ faced block cost	$ 8.55
Laying costs	4.00
Cost in the wall	$12.55
Cost per cubic yard of wall	3.82
Saving per cubic yard in favor of block	1.20
100—8″x8″x24″ faced block cost	$ 9.00
Laying costs	5.00
Cost in the wall	$14.00
Cost per cubic yard of wall	$ 4.27
Saving per cubic yard in favor of block	2.85
100—8″x10″x24″ faced block cost	$10.63
Laying costs	6.00
Cost in wall	$16.63
Cost per cubic yard of wall	4.05
Saving per cubic yard in favor of block	2.47
100—8″x12″x24″ faced block cost	$12.21
Laying costs	7.00
Cost in the wall	$19.21
Cost per cubic yard of wall	3.89
Saving per cubic yard in favor of block	1.13

NUMBER OF BRICK DISPLACED BY CONCRETE BLOCK.

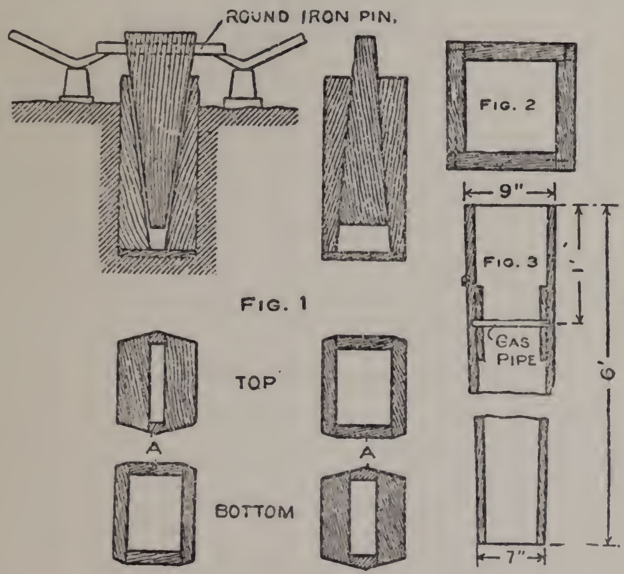
CHARACTER OF BLOCK	SIZE IN INCHES, Mortar Joints Included (Height x Width x Length)	SIZE IN INCHES, Mortar Joints Not included (Height x Width x Length)	Weight in lbs.	Displacement of 100 Blocks in cu. ft.	Material for 100 Blocks in cu. yds. of Concrete.	Number of Blocks per cu. yd. of wall.	Per cent of voids.	Number of Brick displaced by one Block.	Number of Blocks per 100sq. ft.
Solid Veneer	8 x 4 x 16	7¾x 4x15¾	37	29.63	1.05	92	....	7.11	112
Hollow Veneer	8 x 4 x 16	7¾x 4x15¾	29	29.63	.81	92	23.30	7.11	112
Hollow Block	8 x 6 x 16	7¾x 6x15¾	40	44.44	1.11	61	28.75	10.66	112
Hollow Block	8 x 8 x 16	7¾x 8x15¾	50	59.26	1.41	46	32.58	14.22	112
Hollow Block	8 x 10 x 16	7¾x10x15¾	68	74.00	1.90	37	27.61	17.77	112
Hollow Block	8 x 12 x 16	7¾x12x15¾	82	88.89	2.27	31	27.77	21.33	112
Solid Veneer	8 x 4 x 24	7¾x 4x23¾	56	44.44	1.58	61	....	10.66	75
Hollow Veneer	8 x 4 x 24	7¾x 4x23¾	39	44.44	1.10	61	30.20	10.66	75
Hollow Block	8 x 6 x 24	7¾x 6x23¾	64	66.66	1.84	41	22.50	16.00	75
Hollow Block	8 x 8 x 24	7¾x 8x23¾	84	88.85	2.19	31	30.38	21.33	75
Hollow Block	8 x 10 x 24	7¾x10x23¾	104	111.10	2.73	25	30.72	26.66	75
Hollow Block	8 x 12 x 24	7¾x12x23¾	122	133.32	3.27	21	30.95	32.00	75
Hollow 4" Course...	4 x 8 x 16	3¾x 8x15¾	25	29.63	.70	92	32.58	7.11	224
Hollow 4" Course...	4 x 10 x 16	3¾x10x15¾	34	37.04	.95	73	27.61	8.88	224
Hollow 4" Course...	4 x 12 x 16	3¾x12x15¾	41	44.45	1.13	61	27.77	10.66	224
Hollow 6" Course...	6 x 8 x 16	5¾x 8x15¾	38	44.45	1.06	61	32.38	10.66	149
Hollow 6" Course...	6 x 10 x 16	5¾x10x15¾	51	55.56	1.43	49	27.61	13.32	149
Hollow 6" Course...	6 x 12 x 16	5¾x12x15¾	62	66.67	1.70	41	27.77	16.00	149
Hollow 4" Course...	4 x 8 x 24	3¾x 8x23¾	42	44.44	1.10	61	30.38	10.66	150
Hollow 4" Course...	4 x 10 x 24	3¾x10x23¾	52	55.55	1.37	49	30.72	13.33	150
Hollow 4" Course...	4 x 12 x 24	3¾x12x23¾	61	66.66	1.64	41	30.95	16.00	150
Hollow 6" Course...	6 x 8 x 24	5¾x 8x23¾	63	66.66	1.64	41	30.38	16.00	100
Hollow 6" Course...	6 x 10 x 24	5¾x10x23¾	78	83.32	2.05	33	30.72	20.00	100
Hollow 6" Course...	6 x 12 x 24	5¾x12x23¾	92	99.99	2.45	28	30.95	23.99	100
Special "Tabique"..	10.9x3.9x27.7	10.6x3.9x27.5	63	68.30	1.74	40	28.6	16.40	48

Displacement of brick is based on common brick 2¼"x4"x8", including ¼" mortar joints.

*Compiled by Ideal Concrete Machinery Co., South Bend, Ind.

MAKING HOLES FOR BOLTS IN CONCRETE FOUNDATIONS.

When building concrete engine foundations, it is necessary to leave holes of considerable size for the holding down bolts, these holes to be filled up when the bolts are in place. Wood boxes are often used to form the



holes, and these have to be withdrawn after the concrete of the foundation is set. The boxes must be removed from the concrete in some way, either by breaking them in, or drawing on a taper. A taper form is made of solid pieces, with a center wedge, which may be either drawn out or knocked down in and the whole structure withdrawn from the hole, as shown in Fig. 1. This form is used soaked with water, and shrinks as the concrete dries out. The wedge faces are well coated with tallow and graphite and pieces A are made thin and broken out before withdrawal of the pieces of the former.

Another suggestion is to wrap the boxes with two thicknesses of oiled paper so that the concrete cannot touch the wood. The boxes will then come free, leaving the paper wrapping, which can be dug out.

Still another form is that shown in Fig. 2, the box being nailed as lightly as will serve to hold it during the building of the foundation. If the depth is over 4′ it is better to taper the box slightly. In removing, a long

bar is forced down between the concrete and one side of the box, splitting that side, when the three other sides can be taken out whole. The outer surfaces of the boxes should be well rubbed with soft soap. If the concrete be loosely packed around the boxes instead of ramming hard, it will have a rough surface, which gives a much better grip for the later grouting.

One ingenious device is to build into the box a piece of gas pipe, to which a hook can be attached for withdrawing, as shown in Fig. 3. This, with a taper box well oiled and shaken sidewise slightly before the concrete sets, makes an easy job.

STUCCO: WHAT IT IS AND HOW IT IS APPLIED IN BUILDING CONSTRUCTION.

Stucco is a Portland cement plaster applied as a finish to a wall already built, or as the outer portion of a light hollow wall. In a broader sense, the term is used in referring to partitions, ceilings and roofs, as the methods of applying the concrete mixture to the reinforcement are practically the same in all cases.

Given a brick, stone, concrete block or monolithic concrete wall or other surface, a stucco coat can be applied which will in many cases add to the appearance of the surface and always will add to the life of the structure. As a rejuvenator, concrete stucco is without an equal. Take an old residence of brick, stone or concrete, prepare the walls carefully, apply a coat of stucco and you have what appears to be a new building, simple in ornamentation, clean and modest.

In preparing a wall for a stucco coat, clean the surface thoroughly, digging out the mortar from the joints between the brick, block or stone. Then drench the entire wall with water and go over it with a coat of thin, neat cement mortar, brushing the mortar into the pores with a stiff wire brush. The stucco coat should now be applied at once.

If you mix your own aggregates, use cement, sand and hydrated lime in the proportion of 1:3:1. See that the sand is well graded, the particles running from coarse to fine, and use great care in mixing the concrete. The stucco coat may be roughened by adding to the concrete mixture colored gravel or crushed limestone.

In applying the stucco in rough finish, the mixture should be thrown against the prepared wall from a small paddle in the hand of the operator. The stucco should be applied while the wall is still wet with the cement grout. The operator should commence at the upper right-hand corner, working to the left and down, throwing each paddleful as close to the one previously deposited as possible without overlapping. The mixture should be thrown with a jerk, stopping the paddle close to the wall. After two or three yards have been covered, the operator should go back and deposit paddlefuls wherever the coat is thin, but in no case should green stucco be applied to a part of the coat that has dried, as the joining will show. The stucco, where only one coat is applied, should be from 1″ to 1½″ thick.

PROTECTION OF WORK.

The fresh coat of stucco should be kept from drying out too quickly and the wall should be protected from the direct rays of the sun by means of damp canvas or by sprinkling. This is an important point, as the stucco coat should be kept moist for two days after it has been applied.

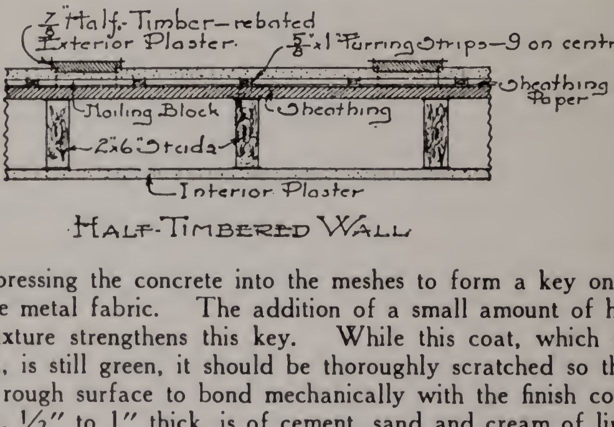
In the case of a wall with a perfectly smooth and comparatively hard face, it is well to clean the surface as described, brush in the cement grout and apply a scratch coat in the proportions mentioned in the latter part of this article, trowelling the plaster into the pores. Scratch this coat while it is green and apply the finish coat in the degree of coarseness desired.

Two coats of concrete are required where metal lath, instead of a solid wall, serves as the base. For instance, in residence construction, a wood frame of studding can be erected the same as for clapboard walls. Sheathing is nailed diagonally to the studs and building paper is tacked on before the 7/8″x7/8″ furring strips are nailed on, over the studs. The expanded metal fabric or wire mesh is nailed to these furring strips.

In the cases of some patented metal fabrics which have stiff ribs to strengthen the sheets, the sheathing is dispensed with. The studs are protected by strips of building paper 6″ wide, running lengthwise of the stud. This paper is painted on both sides with a protecting paint and is held in place by the furring strip nailed into each stud. The wire mesh or expanded metal is then nailed on as in the other case.

APPLYING THE STUCCO.

With the reinforcement in place, the first coat, mixed in the proportions of 2:5:1, cement, sand and cream of lime, is applied with a trowel, the



HALF-TIMBERED WALL

operator pressing the concrete into the meshes to form a key on the inner side of the metal fabric. The addition of a small amount of hair to the plaster mixture strengthens this key. While this coat, which should be ½″ thick, is still green, it should be thoroughly scratched so that it will present a rough surface to bond mechanically with the finish coat. The finish coat, ½″ to 1″ thick, is of cement, sand and cream of lime, in the proportion of 1:3:1, with some waterproofing compound added, and is applied before the scratch coat has set. The precautions mentioned above against too rapid drying of the stucco should be taken. In every case in which stucco is used, the concrete should be mixed up in batches of such size as can be handled immediately, as it is of the utmost importance that the stucco be applied as soon as it is mixed.

There are several different makes of metal lath and wire mesh and special characteristics of patented laths require special attention to their use. It is believed, however, that the suggestions given here apply to nearly all of the different metal fabrics now on the market.

The addition of waterproofing to the finish coat insures a dry wall. Where wood studs are used this is important, as it prevents the decay of the wood members, resulting from dampness. The prepared building paper

between the stud and the furring strip adds further protection to the former.

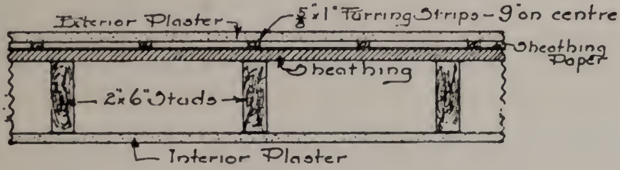
The cream of lime added to the concrete allows the mixture to work up better under the trowel.

VARIOUS USES OF STUCCO.

Similar methods are employed in building light roofs, partitions and floors of concrete. In the case of floors, there are patented forms of expanded metal mesh which are stiff enough to act as centering and reinforcement at the same time. The metal mesh is laid across the beams (steel, concrete or wood) and the concrete poured on. The mixture flows through the lath only enough to form a key on the under side and present a rough surface to receive the ceiling finish. The upper surface is finished as in other concrete floor work. This method is, of course, used only in short spans, where comparatively light loads are to be borne.

Roofs are similarly constructed, with thinner slabs. Good roofs for shops, and other small buildings, can be built with the entire thickness measuring 1¼″.

In partition work, stiffened sheets of steel fabric are set up and concrete plaster applied to both sides. Where hollow partitions are desired,



·PLAIN PLASTERED WALL·

expanded metal mesh is tacked to both sides of steel or wood studs, and the concrete plaster applied and finished.

Garages, silos, greenhouses, poultry houses and other small structures in which little bearing is carried by the walls are built economically of concrete stucco on metal lath. The possibilities of this scheme of construction are without limit as the cost is low compared with that of other forms. While not absolutely fireproof, concrete stucco construction is safer than wood and, considering its long life, is practically as cheap.

The process of giving a new coat to an old frame house by the use of stucco is simplicity itself. The clapboards are ripped off the house and the window casings removed. Furring strips are tacked to the sheathing, which has been covered with a double sheet of building paper. Wire mesh or expanded metal lath is nailed to the furring strips and the stucco is applied as described above. The result is a house that from the outside may appear to be of monolithic or reinforced concrete, or of brick or stone with stucco finish. It is as nearly fireproof as a building of brick veneer, costs less and looks better. We have known of numerous instances in which old, run-down homesteads have been given new life and made modern by the expenditure of a small amount of money in giving the structure a stucco exterior.

STRENGTH OF CONCRETE BRICK AND TESTS FOR ABSORPTION.

The recent extensive use of concrete brick by the Plymouth Cordage Co., Plymouth, Mass., demonstrated several valuable facts. For the construction of the company's new mill, having an aggregate wall length of nearly one-fifth of a mile, almost two and one-half million concrete brick were made upon the ground.

The mixture used in the major part of the work was 3 parts sand to 1 part cement. A few brick were made of 4 parts sand to 1 cement, for lightly loaded walls.

TABLE I. ABSORPTION OF CONCRETE BRICK.

	WEIGHT.				
	Dry.		Saturated.		Absorption.
Brick.	lbs.	oz.	lbs.	oz.	oz.
Face	5	8½	5	10	1½
Common inside	5	8	5	11	3
Facing material*	5	9½	5	10	½
Hard burned body clay brick	4	11	5	7	12

The brick used on the outside of the buildings had a facing, ⅛″ thick after compression, of 2 parts fine sand and 1 part cement, with the addition of 2 per cent waterproofing, by weight, to the cement. Enough water was used to make a mortar of such consistency that it would hold its shape under compression, without flushing water to the surface so as to cause the mortar to stick to the plates. No definite percentage can be given as to the amount of water, as that is governed largely by temperature and atmospheric conditions, but the average amount was about 8 per cent.

TABLE II. TESTS OF STRENGTH OF CONCRETE BRICK.

Test "A." Face brick; body, 3 parts sand to 1 part cement; facing, 2 parts fine sand to 1 part cement; 2 per cent waterproofing compound added to cement by weight. Facing ⅛″ thick after compression:

Age. Days.	1st Crack. lbs.	Ultimate Strength. lbs.	Per sq. in. lbs.
56	87,100	87,100	2730
120	100,900	108,650	3400
239	128,500	132,650	4145

*Brick made entirely of the material used for facing the outside brick.

Test "B."	Common brick; 3 parts sand to 1 part cement.		
56	69,750	71,200	2215
92	95,000	99,100	3080
120	119,700	119,700	3735
239	129,000	134,100	4095
275	162,100	164,600	5160
Test "C."	Common brick; 4 parts sand to 1 part cement.		
56	74,150	76,500	2390
120	89,050	91,450	2810
239	119,500	126,400	3905
"Test "D."	Common brick; 5 parts sand to 1 part cement.		
56	72,150	72,150	2240
120	80,700	86,650	2675
239	110,000	119,950	3710
Test "E."	Two hard-burned "body" clay bricks.		
...	101,000	150,000	4770
...	94,000	162,000	5470

Care in curing the brick (that is, constant wetting), will overcome to a large degree any minor weakness which is theoretically developed by a "dry mix."

To the uninitiated, the small quantity of water used would seem likely to produce a porous brick having a strong attraction for water, with damp buildings as the result of their use. As a matter of fact, these brick do not absorb water to any great extent. Brick 30 days old, carefully dried and then submerged in water for 16 hours, showed the results given in Table No. 1.

Table No. 2 shows the results of tests made under the direction of the Ordnance Department of the U. S. Army at the Government Arsenal in Watertown, Mass. The factors are averages unless otherwise noted.

In the tests, some peculiar phenomena were noticed. The best test on a 3:1 brick shows 5,460 lbs. per sq. in. The best on a hard burned "body" clay brick showed 5,470 lbs. per sq. in. The average on the clay brick was 5,120 lbs., or slightly less than that for the average concrete brick at nine months.

Two brick made at the same time, from the same stock, show varying results. For instance, two brick (3:1) 275 days old—1, first crack at 155,200 lbs. and ultimate strength 155,200 lbs.; 2, first crack at 169,000 lbs. and ultimate strength 174,000 lbs. Compare that with the clay brick—1, first crack at 94,000 lbs., and ultimate strength 162,000 lbs.; 2, first crack at 101,000 lbs., and ultimate strength 150,000 lbs. Average results show the first crack to be 97.4 per cent of the ultimate strength for 3:1 concrete brick, 96 per cent for 4:1 brick, and 94.3 per cent for 5:1 concrete brick; and 62.5 per cent for clay brick. The lowest percentage shown in any concrete brick was 87.6 per cent.

MANUFACTURE AND INSTALLATION OF CONCRETE FENCE POSTS.

Concrete posts are attracting the attention of all farmers, and the agricultural colleges throughout the country have recognized this fact. Various experiments have been conducted with a view to determining the best methods of molding fence posts and the best ways for setting them on the fence line. At Fort Collins, Colo., H. M. Bainer and H. B. Bonebright, in charge of practical farming experiments for the Colorado Agricultural College, have made some investigations into this subject and have published a bulletin containing their conclusions. This matter is intended for the information of the man who knows little of concrete methods and who must be provided with safe rules for operating. The instructions are prejudicial to no patented system of post manufacture and most of the rules could be applied with profit, no matter what special molds are used. While the methods described will be most valuable to the post maker who has limited facilities, the cost of the product could of course be reduced, and the quality improved, by the use of modern equipment in the way of post molds and machines, mixers, etc.

The following suggestions for concrete post specifications are taken from the Bainer and Bonebright bulletin referred to above:

The average life of the best wood fence posts that have not been specially treated is from 12 to 15 years; while the poorer ones often last but from 3 to 5 years. Good wood posts are gradually becoming harder to secure and the cost of them is increasing each year. The cost of maintaining the farm fences, and especially the posts, is a great one when we consider that they must be replaced so often.

The cheaper and poorer grades of woods used for fence posts can be treated and thus made to outlast the best grades of untreated timber. The cost of the untreated posts will vary from 10 to 15 cents each and the cost of treating them, according to experimental data at hand, will add from 10 to 15 cents each to the first cost, thus making the total cost of the treated post from 20 to 30 cents.

With the present enormous and increasing demands made upon our forests for all classes of lumber, shingles, pulp wood, cooperage stock, mine timbers, lath, wood for distillation, poles and fence posts, there is no wonder that the prices for these products are becoming higher. The cost of the average fence post is almost double what it was a quarter of a century ago, and in another quarter of a century there is no doubt that its cost will be double what it is at present.

Iron fence posts cannot be generally used as substitutes, as their cost is prohibitive. Stone posts are used in some localities, but they do not give general satisfaction and they cannot be profitably shipped.

Concrete posts are just beginning* to be manufactured and used as substitutes, and there is no doubt that they will become more generally used. It is true that they may be considered expensive, but they are long-lived, present a good appearance, and can be made by the farmer, providing the necessary materials are available. It is our purpose to show how to make the posts and also to determine the best forms, mixtures, reinforcements, wire fasteners, cost, and general practicability.

MATERIALS TO USE.

Cement.—There are but two general classes of cements which could be used for post construction—natural and Portland. The materials found in natural cement are mixed by nature in approximately the correct proportions, and when burned do not always make a cement of uniform strength. Portland cement is mechanically mixed in chemically correct proportions. Portland cement makes a uniformly stronger mixture than the natural cement and is always used where great strength is required.

In concrete fence post construction, it is desirable that the post be made as light and as strong as possible, and thus it is practical to use nothing but the best grade of Portland cement.

Sand.—Clean, sharp sand, with grains varying in size from small to large, makes the best mixture. By clean sand is meant that which is free from clay, loam, or foreign materials. These tend to retard the proper setting of the cement and destroy its adhesive quality. In many sections mica is found mixed with sand in large enough quantity to interfere seriously with the strength of a mixture made from it.

Sharp sand is composed of sharp, angular grains of all sizes and makes better mixture than that which is smooth and round, or "river worn."

A sand composed of fine and coarse grains mixed is to be preferred, because less cement will be required to fill the voids.

Leaves, sticks, stones or gravel should be removed by screening.

Gravel.—The same general rules used in the selection of a good grade of sand will apply to gravel. It should be composed of clean, sharp pebbles of all sizes. For post construction, the pebbles must not be too large, as they will interfere with the proper placement of reinforcement.

Broken Stone.—Broken stone used for post construction must contain no large pieces, as they will interfere with placing the reinforcement. It is necessary to use some sand with the stone to fill voids and thus save cement. It is not desirable to use soft sandstone, soft limestone, slates, or shales. Granites, hard limestones, and coarse gravel which has been crushed, are considered best.

Water.—The water used in making a concrete mixture should be clean and free from alkali. Satisfactory experiments have not been conducted to show the effects of alkali water used in making a mixture of this kind, but enough is known as to its effect on cured cement constructions to justify not using it in the mixture.

PROPORTIONS.

On account of a difference in the total open space or voids in sands or gravel composed of different sized particles and also because more cement is

*Concrete posts have been used in some localities for the past ten years and are giving excellent satisfaction.

required in some conditions than in others, it is often necessary to make a rough determination of the percentage of voids to the total aggregate. Where maximum strength is required about 10 per cent more cement should be used than the total voids.

The determination may be made as follows: Secure a water tight box or pail of known capacity, fill it with the aggregate to be used so that when it has been well shaken it will smooth off even at the top. Pour water of known amount into this until full. The volume of water used in proportion to the total volume of the receptacle determines the total voids.

For example, suppose the total volume of the receptacle in which the aggregate is placed is 2,032 cubic inches and that it takes two gallons of water to fill it. One gallon of water contains 231 cubic inches and two gallons would contain 462 cubic inches. The total volume of water used, divided by the volume of the receptacle holding the aggregate represents the proportions of voids. Thus, 462 divided by 2,032 equals 22.73, or the voids make up 22.73 per cent of the total volume. For the maximum strength 10 per cent should be added to this. Ten per cent of 22.73 equals 2.27. By adding this 2.27 to 22.73 we obtain 25, or, in other words, 25 per cent of the total volume should be cement. The mixture in this case would be represented by one part of cement to four parts of aggregate.

The proportions used in the construction of the fence posts in this bulletin varied from 1 part cement and 3 parts of sand to 1 part of cement and 5 parts of sand. In others gravel was used in the proportion of 1 part cement, 3 parts sand, and 3 parts gravel. It is a difficult matter to use broken stone or gravel in large quantity and place the reinforcement properly.

Measure all materials in correct proportions. This may be done with a shovel, a pail, wheelbarrow, or barrel. It will usually be advantageous to measure the water, especially where small quantities are mixed or where the same amount of mixture is made several times.

MIXING.

Hand Mixing.—Where the mixing is done by hand, a flat water-tight platform or shallow box is convenient. Measure the sand and place it in a uniform layer and over this spread the proper amount of cement. Mix this thoroughly before adding water until it shows a uniform color. The rule is to shovel it over at least three times. Now spread out the mixture, making a sort of basin, into the middle of which the greater part of the water may be poured. Work in the dry edges until the water disappears, then add enough more water in small amounts to make the mixture of the desired consistency. Do not mix more material than can be used in twenty minutes.

REINFORCEMENT.

Concrete work has the property of resisting great crushing stresses, but when subjected to tensile stress the best of it breaks very easily. For this reason it becomes necessary to put some material possessing great tensile strength into the post, in order that the full crushing strength of the cement or concrete may be utilized. Steel is the most satisfactory material from which to make the reinforcement.

The reinforcement should be placed in the post as near the corner as possible. This places it as far as possible from the neutral axis, thus giving it the greatest advantage in strengthening the post. In order that the reinforcement may be properly held and protected by the concrete, it is a good plan to place it from ⅜″ to ¾″ in from each side. This insures a good, firm grip of the concrete upon the reinforcement. The material used for reinforcement should be strong, light, and rough enough to permit the mixture to get a firm grip upon it. It should be very rigid, with little or no tendency to spring or stretch. A great many special reinforcements are now being made.

If twisted wire is used, cut to the right length and packed in bundles in the same way as bailing wire, it is best to procure it in this way. In case the twisted wire comes in rolls, it becomes necessary to straighten each piece before it can be used. In this case, it is best to purchase common smooth wire of the desired size and twist it on the farm. The twisting is easily done by tying one end of each wire to the opposite spoke of the fly wheel of some machine; a corn sheller or hand cider mill will serve the purpose very well. By tying the other ends of the wire to a weight which may drag along upon the ground, from 100 to 200 feet of wire may be twisted in a very few minutes.

In case a small engine is available the twisting becomes still easier. The advantage of the home twisted wire over twisted wire which is bought in rolls lies in the fact that the former is straight at the end of the twisting process, while the latter is bent and must be straightened.

The cutting of the wire is best accomplished as follows: Set a cold chisel (with the edge up) in a low, rough bench, and nail a block to the bench at a distance exactly equal to the length of the reinforcement wire from the edge of the chisel. Take a light hammer in the right hand and seize the twisted wire with the left. Then drag the wire over the chisel until the end of it strikes the block, when a light blow directly over the chisel easily cuts the wire. The piece which is cut off is now laid to one side and the end of the main wire is drawn to the block and another piece cut off.

SPECIAL REINFORCEMENT.

Some have suggested that a piece of wood be placed in the center of the post as a reinforcement. This must be considered a failure, as the wood shrinks and expands by differences in moisture conditions. When it absorbs water, it is likely to swell and burst the post, and again when it dries it will shrink away from the concrete.

Gas pipe has also been suggested as one of the best materials to use as a reinforcement. In case plenty of strong second-hand pipe is at hand, this may be true. As the pipe is placed in the center of the post, it is not in position to act to the best advantage as a reinforcement, and for this reason it should be strong enough to withstand all the strain. New pipe would make the posts altogether too expensive.

Crimped wire is also claimed, by some, to be superior to that which has been twisted, but as the pull comes upon the wire there is a tendency to straighten the crimps. When the wires happen to be near the surface, there is great danger of the post being split by this straightening process.

Band iron and strap iron are also being used as reinforcement. In case the mixture has a good chance to get a grip on the iron, it will probably prove satisfactory, but unless the iron is roughened there is danger of it slipping.

For very large posts, the twisted steel rods will prove as satisfactory as twisted wire.

CURING THE POSTS.

In order for the cement to become thoroughly cured or "set," water must be supplied to aid in the action. This action goes on for a long time, some authorities estimating the total period at from 15 to 20 years. For the first thirty days the concrete should be kept wet if the best results are to be expected. This means that the posts must be kept wet, and the question arises, what is the best system of keeping them in this condition?

The answer is a simple one. The most favorable conditions for conserving the moisture consist in curing the posts in a shed where the wind does not strike them. Under these conditions neither the sun's rays nor the wind have a chance to dry out the posts too rapidly. The only thing that now remains is to keep the posts in a wet condition.

After the posts are placed in an upright position in the curing shed, as described below, sprinkle them thoroughly every day. This may be done either by a hose and nozzle in connection with some form of pressure supply tank or by means of a garden sprinkler. In the latter case provision must be made so that the person doing the work may walk upon some structure above the tops of the posts.

The posts should be thoroughly sprinkled every day for at least 30 days.

HANDLING THE POSTS.

In removing the posts from the molds great care must be taken not to allow the posts to sag or crack. A post may be cracked in handling and still be fit for service, but it cannot be considered to be as valuable as an uncracked one.

There are two general methods of removing the posts from the molds. The first method consists in laying the molds with the posts in them on a level bed of soft sand. The mold is then turned upside down and the post allowed to settle into the sand. The mold is next removed and the post allowed to remain undisturbed for several days. When the post is sufficiently strong it is placed in an upright position to be cured. While this method requires more space it is perhaps a little better for the posts than the second method.

The second method consists in removing the posts from the molds while in an upright position. The post is then allowed to lean against a wall or some other support. Thus only one handling is necessary. Care should be taken to have the bottom of the post close to the wall, as it is very likely to break if not kept in a very nearly upright position.

After the posts are cured and ready to set they should be moved from the curing shed and hauled to the fence line in a wagon having a strong, rigid bed. The bottom of the wagon should be covered with a layer of straw to prevent breakage. Not more than three to four layers of posts

should be placed in the wagon, depending upon road conditions. It must be remembered that a five-inch post weighs 100 pounds or more. When this is considered we see how easy it is to load a wagon and also how sufficient weight may be placed on the posts in the lower layer to cause them to break.

In handling and setting care must be taken not to drop the posts. The weight of the post places unnecessary stress upon the different parts, and in case it is dropped there is great danger of it being cracked or destroyed. A careless workman can easily do more damage to the posts than his services are worth.

CORNER POSTS AND GATE POSTS.

In building a fence with concrete posts, the corner and gate posts must be especially strong, so as to prevent the pull of the wires coming upon the line posts. All the pull of the wires should be borne by the corner or gate posts. With this in mind the designer should aim not only to build a very strong post, but the system of bracing should receive special attention.

As the concrete posts are not at first so strong as wood posts, we cannot use the same bracing systems which are so commonly in use in wood post fence construction. It has been found advisable to place the brace so that it supports the post at a point very little, if any, above the middle of the post. For the reason that the posts are strong in compression, but do not stand as much pull as wood posts, it proves advisable to place the brace against the brace post at least one foot below the ground line; thus the post distributes the pressure at the end of the brace against an area of ground equal to the surface covered on the opposite side of the post.

There should be several wires connecting the brace post and the corner or gate post together. These wires should be placed under the ground at a depth of about one foot. By having these wires tight the corner post cannot move unless the brace post moves, and as this is securely fastened to it, the whole becomes a unit, offering a rigid resistance to the pull of the fence.

In the case of a corner post, the wires may be fastened by wrapping them around it, but the most satisfactory way is to cast wire staples in the post. These staples should extend into the post far enough to be wrapped around one or more of the reinforcement wires.

The hinges for gates may also be cast in the post when it is desired to do so.

Corner and gate posts are usually reinforced in the same way as line posts. It is unnecessary, however, to place reinforcing wires on the inner sides of the corner posts, as the outer sides bear almost all of the tension.

With the tapered posts, it is desirable to construct the face sides straight; this brings all of the taper on the other two sides. Small lugs or shoulders should be cast on each brace side of the post, against which the brace is placed.

The ordinary 5″ line post proves to be strong enough to act as a brace post for an 8″ corner post.

N. A. C. U. SPECIFICATIONS FOR CONCRETE SIDEWALKS.

Materials.

The cement shall meet the requirements of the specifications for Portland cement of the American Society for Testing Materials, adopted by this Association (Specification No. 1), January, 1906.

Aggregates.

Fine aggregate shall consist of sand, crushed stone or gravel screenings, graded from fine to coarse, passing when dry a screen having ¼″ diameter holes, shall preferably be of silicious materials, clean, coarse, free from vegetable loam or other deleterious matter, and not more than 6 per cent shall pass a sieve having 100 meshes per linear inch.

Mortars composed of one part Portland cement and three parts fine aggregate by weight when made into briquettes shall show a tensile strength of at least 70 per cent of the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand.

Coarse aggregate shall consist of inert material, graded in size, such as crushed stone, or gravel, which is retained on a screen having ¼″ diameter holes, shall be clean, hard, durable, and free from all deleterious materials. Aggregates containing soft, flat or elongated particles, shall be excluded.

The maximum size of the coarse aggregate shall be such that it will not separate from the mortar in laying and will not prevent the concrete fully filling all parts of the forms. The size of the coarse aggregate shall be such as to pass a 1¼″ ring.

Water shall be clean, free from oil, acid, strong alkalis, or vegetable matter.

Forms.

Forms shall be free from warp, and of sufficient strength to resist springing out of shape. All mortar and dirt shall be removed from forms that have been previously used.

The forms shall be well staked to the established lines and grades, and their upper edges shall conform with finished grade of the walk, which shall have sufficient rise from the curb to provide proper drainage; but this rise shall not exceed three-eighths (⅜) of an inch per foot, except where such rise shall parallel the length of the walk.

Forms shall be thoroughly wetted before any material is deposited against them.

Size and Thickness of Slabs.

Slabs shall not contain more than 36 square feet nor have any dimension greater than six (6) feet, except as hereinafter provided.

Where a greater slab area is desired, a maximum area of 625 square feet is allowed, when the slab is reinforced with ¼″ bars in both directions, at least every nine (9) inches, or their equivalent.

The minimum thickness of slabs shall not be less than four (4) inches.

Sub-Base.

The sub-base shall be thoroughly rammed, and all soft spots removed and replaced by some suitable material.

When a fill exceeding one foot in thickness is required, it shall be thoroughly compacted by flooding and tamping in layers of not exceeding six (6) inches in thickness, and shall have a slope of not less than one to one and a half.

The top of all fills shall extend at least twelve (12) inches beyond the sidewalk.

While compacting, the sub-base shall be thoroughly wetted and shall be maintained in that condition until the concrete is deposited.

Base.

The concrete for the base shall be so proportioned that the cement shall overfill the voids* in the fine aggregate by at least five (5) per cent, and the mortar shall overfill the voids in the coarse aggregate by at least ten (10) per cent. The proportions shall not exceed one (1) part of cement to eight (8) parts of the fine and coarse aggregates.

When the voids are not determined, the concrete shall have the proportions of one (1) part cement, three (3) parts fine aggregates and five (5) parts coarse aggregates. A sack of cement (95 pounds) shall be considered to have a volume of one (1) cubic foot.

Mixing.

The ingredients of concrete shall be thoroughly mixed to the desired consistency, and the mixing shall continue until the cement is uniformly distributed and the mass is uniform in color and homogenous.

(*a*) *Measuring Proportions.* Methods of measurement of the amounts of the various ingredients, including the water, shall be used, which will secure separate uniform measurements at all times.

(*b*) *Machine Mixing.* When the conditions will permit, a machine mixer of a type which insures the proper mixing of the materials throughout the mass shall be used.

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*To determine voids, fill a vessel with sand and let net weight of sand equal B. Fill same vessel with water and let net weight of water equal A.

$$\text{Per cent voids} = \frac{A \times 2.65 - B}{A \times 2.65} \times 100$$

This formula may also be used in determining voids in crushed stone and screenings by substituting for 2.65 the specific gravity of the stone.

The following is a more simple method for determining voids in coarse aggregate. Fill a vessel with the aggregate and let net weight equal B. Add water slowly until it just appears on the surface and weigh. Let net weight equal A. Fill same vessel with water and let net weight equal C.

$$\text{Per cent voids} = \frac{A - B}{C} \times 100$$

Use a vessel of not less than one-half (½) cubic foot capacity. The larger the vessel, the more accurate the result.

(*c*) *Hand Mixing.* When it is necessary to mix by hand, the mixing shall be on a water-tight platform and especial precautions shall be taken to turn the materials until the mass is homogeneous in appearance and color.

(*d*) *Consistency.* The materials shall be wet enough to produce a concrete of such a consistency that water will rise to the surface of the mass under light tamping, and, on the other hand, one that can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar.

(*e*) *Retempering.* Retempering mortar or concrete, *i. e.*, remixing with water after it has partially set, shall not be permitted.

Placing of Concrete.

(*a*) *Methods.* Concrete after the addition of water to the mix shall be handled rapidly to the place of final deposit, and under no circumstances shall concrete be used that has partially set before final placing.

(*b*) *Freezing Weather.*. Concrete shall not be mixed or deposited at a freezing temperature unless special precautions are taken to avoid the use of materials containing frost or covered with ice crystals, and in providing means to prevent the concrete from freezing after being placed in position and until it has thoroughly hardened.

Walks shall be laid in such a manner as to insure protection of the pavement from injury caused by change in the foundation or by contraction and expansion.

Workmen shall not be permitted to walk on freshly laid concrete, and where sand or dust collects on the base it shall be carefully removed before wearing surface is applied.

Wearing Surface.

The wearing course shall have a thickness of at least one (1) inch.

Mortar for this course shall be mixed in the same manner as the mortar for the base, but in the proportion of one (1) cement to two (2) of fine aggregate, and it shall be of such consistency as will not require tamping, but will be readily floated with a straight-edge.

The wearing surface shall be spread on the base immediately after mixing, and in no case shall more than fifty (50) minutes elapse between the time that the concrete for the base is mixed and the time that the wearing course is floated.

After being worked to an approximately true surface, the slab markings shall be made directly over the joints in the base with a tool which shall cut clear through to the base and completely separate the wearing courses of adjacent slabs.

Slabs shall be rounded on all surface edges to a radius of not less than one-half (½) inch.

When required, the surface shall be troweled smooth.

On grades exceeding five (5) per cent, the surface shall be roughened. This may be done by the use of a grooving tool, toothed roller, brush, wooden float or other suitable tool; or by working coarse sand or screenings into the surface.

Where color is used, the quantity and quality shall be such as not to impair the strength of the wearing surface.

Color shall be added in such a manner as to insure a uniform tint.

The application of neat cement to the wearing surface in order to hasten the hardening is prohibited.

Single Coat Work.

Single coat work shall be composed of one (1) part of cement, two (2) parts of fine aggregate and three (3) parts of coarse aggregate, and the pavement shall conform in all respects to the specifications for two-coat work.

The concrete shall be firmly compacted by tamping and evenly struck off and smoothed to the top of the form. Then, with a suitable tool the coarser particles of the concrete shall be tamped to a depth which will permit of finishing the walk as under "Wearing Surface."

Protection.

When completed, all walks shall be kept moist and protected from traffic and the elements for at least three days. The forms shall be removed with great care, and upon their removal the edges of the walk shall be protected in a suitable manner.

Curb and Gutter.

For curb, the trench shall be excavated to a depth not greater than the required bottom of the curb and a width not greater than the required width of the curb plus six (6) inches. The minimum thickness of the curb shall not be less than six (6) inches. Concrete shall be deposited at one operation and firmly tamped to within one (1) inch of the top of the forms. The wearing surface shall then be placed only where the curb is to be exposed, of the same composition as that specified for sidewalks.

Joints shall then be made three-quarters (¾) of the total depth of the curb continuous with those in the sidewalks, and in no case more than six (6) feet apart. The forms shall be removed as soon as practicable, when the surface shall be finished at one operation.

Combination curb and gutter shall be formed and finished, where required, at one operation.

SIDEWALK HINTS AND SUGGESTIONS.

Do not attempt to use a mixture of concrete after the set has begun.

Avoid the use of sand that is too fine. If you use it, you will have trouble.

Moisten the coarse aggregate well before adding the cement. It assists the cement in adhering to the particles.

Don't scatter Portland cement on the surface of your finished work. If you do, you will have difficulty at that particular point.

In preparing the excavation for a concrete sidewalk, absolute drainage is essential, if trouble from freezing water, with consequent expansion, is to be avoided.

Shade trees should be set not less than four feet from the walk and in the case of trees whose roots run close to the surface of the ground, a distance of ten feet is still better.

Union between the top and the bottom coat is best accomplished by

tamping them together. Have enough water so that the air in the concrete will escape when the tamping is done.

Be sure that your bottom coat is still moist and fresh when the top coat is applied. Otherwise, the two will not join. Be careful, too, that no dust or dirt is lying on the bottom coat, or you will fail to get a bond.

Some walk-makers sprinkle thoroughly slacked lime that has been finely ground, on the surface of the walk before it has begun to harden. This practice tends to delay the set a little and also produces a good color effect. Lime that has been prepared in this manner, added to the cement used in the top dressing or coat, will whiten the walk and assist in shedding the water.

Finish the walk while the upper surface is still moist and easily worked. Avoid too much use of the trowel. In the action of this tool, a vacuum is created between the surface of the walk and that of the trowel, with the result that particles of neat cement are drawn to the surface, where they dry out and are worn off, with the result that the top coat is robbed of its proper proportion of cement. If the walk is finished after it has begun to set, the resulting surface will be brittle. It will crumble easily.

Where broken brick and cinders are used in filling in the excavation, it is wise to tamp them as solidly as possible and to cover them with a layer of sand in order to prevent opposite action in expansion from freezing. One contractor explains the action of frost in cracking walks by saying that the ground expands, owing to the action of the freezing water, while the hardened concrete contracts from the cold. The two forces act in direct opposition, so some means should be taken to prevent the subsoil from freezing to the lower surface of the walk. Careful provision for drainage will avoid this danger.

Albert Moyer, a sidewalk expert, suggests the advisability of making the entire walk a uniform slab of closely compressed, carefully selected stone. Just before the surface dries, he advocates scrubbing it with a wire brush, of the kind used in cleaning boilers. A gentle stream of water played from a hose in the path of the brush will assist in removing the thin skin of neat cement which gives the walk its original neat finish, but which in time wears off under traffic. For walks in which appearance is not the first consideration, this suggestion is an excellent one, as it produces a walk of first-rate wearing qualities.

PORTLAND CEMENT PRODUCTION.

Figures on cement production are always interesting and we have at hand the report of the production of cement in this country in 1908, made by the U. S. Geological Survey. The year's output, as shown by the reports of the producers, was 52,775,925 barrels, valued at $44,376,656. This total was made up as follows:

	Barrels.	Value.
Portland cement	51,002,612	$43,472,679
Natural cement	1,621,862	808,509
Puzzolan cement	151,451	95,468
	52,775,925	$44,376,656

The corresponding figures for the calendar year 1907 are given below for purposes of comparison:

	Barrels.	Value.
Portland cement	48,785,390	$53,992,551
Natural cement	2,887,700	1,467,302
Puzzolan cement	557,252	443,998
	52,230,342	$55,903,851

The report says: "The average price of the entire Portland cement output in 1908 was only 85 cents a barrel—36 cents below the average price in 1907. The 1908 price is the lowest on record, the previous low point—88 cents a barrel—having been reached in 1904 as the result of business depression in that year."

The figures showing the 1909 production will not be published until late in 1910.

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SIZES OF SLABS IN CONCRETE SIDEWALKS.

Emphasis is laid elsewhere in this book upon the importance of clean-cut expansion joints in concrete sidewalks. The frequency of these joints in sidewalks of varying width is a point on which many contractors are not clear. C. W. Boynton, an authority on sidewalk specifications, gives the following directions as to the size of sidewalk slabs:

In 24″ walk make the slabs 30″ long
In 30″ walk make the slabs 36″ long
In 36″ walk make the slabs 42″ long
In 42″ walk make the slabs 50″ long
In 48″ walk make the slabs 60″ long
In 60″ walk make the slabs 72″ long

WEIGHT OF CONCRETE BUILDING TILE.

With the advent of concrete hollow tile, similar in shape to terra cotta building units, the question of weight becomes interesting and a prominent manufacturer of concrete building tile furnishes us with figures based on the 40-lb. weight of a 10″ wall tile of concrete.

Material	Lbs. per Cu. Ft.
Hollow Concrete Tile............	54
Terra Cotta Tile................	60
Brick	100 to 140
Marble or Limestone	164

* * *

REINFORCING CIRCULAR WATER TANKS.

Owing to the difference in stresses, water tanks above ground require reinforcement different from that of silos. The reinforcement should be in the middle of the concrete wall. For ordinary purposes a wet mixture 1:2:4 is best for this work. In spacing plain round or square rods for such tanks, the following table will serve as a guide:

Depth. Feet.	Diameter. Feet.	Thickness of Concrete in wall. Inches.	Diameter of Horizontal rods. Inches.	Spacing Horizontal rods at bottom. Inches.	Spacing Horizontal rods at top. Inches.	Diameter Vertical rods. Inches.	Spacing Vertical rods. Inches.
5	5	6	¼	8	18	¼	36
5	10	6	¼	6	12	¼	30
10	10	8	⅜	6	18	⅜	36
10	15	9	⅜	4	18	⅜	36
15	10	10	⅜	4	18	⅜	30
15	15	12	½	6	20	⅜	30

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CONCRETE VALUES OF DIFFERENT STONES.

The strength of concrete depends upon the strength of the aggregates used. Toughness and hardness are the qualities most to be desired in crushed stone for concrete. The following list of stones, printed in the order of their natural value in concrete work, will be of assistance to the concrete man:

Trap, quartz gravel, limestone (hard), granite, marble, limestone (soft), slag, sandstone, slate, shale and cinders.

* * *

CLAY FOR WATERPROOFING CONCRETE.

Experiments in the laboratory show that finely divided colloidal clay, in proportions running from 5 to 12 per cent, produces a fairly efficient water proofing effect in concrete. The clay must be very finely divided—preferably to diameters that will entirely pass a 200-mesh sieve. Concrete made in this manner is shown to be impervious to water, but is not necessarily free from absorbing moisture.

LINING ELEVATOR SHAFTS WITH CONCRETE.

If the walls are terra cotta or brick, cut the mortar from the joints to a depth of half an inch, soak the wall thoroughly with water and apply a scratch coat of one cement and two sand. Then apply a stucco coat of one part white cement and two parts white marble screenings or white sand, all passing 1/8" mesh and graded in size to particles all of which will be retained on a No. 50 screen. Keep the finished wall damp as long as convenient.

To give this surface a sparkling appearance, when it has cured, wash with dilute sulphuric acid, one part acid to five parts water. Apply two or three coats of this, then wash the wall with water played from a hose.

* * *

CONCRETE LININGS FOR REFRIGERATORS.

In lining refrigerators, concrete may be made to replace tile by using the following directions: Mold slabs that will fit the inside of the refrigerator,using plate glass as a molding board. Oil the glass with vaseline applied with a cloth. Use a very wet mixture of one part marble screenings to two parts white cement. Avoid air bubbles by thorough "working." Lay over this concrete a strip of expanded metal or wire mesh (small mesh chicken wire will do in some cases) cut to size, and apply the rest of the mortar, bringing the slab up to the required thickness. Cover the surface with damp cloths. Keep the slab wet for three days, and sprinkle daily with water for a week afterward. When removed from the glass plate, the under surface will rival expensive tile in appearance.

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COST OF MAKING CONCRETE FENCE POSTS.

Cost figures on fence posts, as on every other concrete product, are subject to local conditions. To give the reader an idea of the possibilities in the manufacture of concrete posts we print here an estimate of costs prepared by an Indiana manufacturer, using "D. & A." strap steel reinforcing and making a wet mixture post, seven feet long.

COST OF MATERIAL.

	Cost	*Will Make*	*Cost Per Post*
1 yard of gravel,	$ .60	40 posts	$ .01½
1 bbl. (4 sacks) cement,	1.50	24 posts	.06¼
100 lbs. reinforcing,	3.25	56 posts	.05¾
Total,			$ .13½

Figuring 12 posts for an hour's work:

One man per day,	$1.75	or 17½ cents per hour.
One boy per day,	1.00	or 10 cents per hour.
Labor for 120 posts,	$2.75	or 27½ cents per hour.
Costs of labor per post,	$ .02¼	
Cost of material per post,	.13½	
Total,	$ .15¾	per post.

WEIGHTS OF CONCRETE AND OTHER ROOFING TILE.

In figuring on roofing jobs, the contractor must know the comparative weights of different kinds of roof coverings. A manufacturer of corrugated concrete roofing tile submits the following figures of weight per square (100 square feet):

Burnt Clay Tile..........	800	to	1,600	lbs.
Slate	750	to	950	lbs.
Concrete Tile	600	to	650	lbs.

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AGE OF CONCRETE BRIDGE ARCHES.

The Grand Maitre bridge, Fontainebleau Forest, France, has an arch span of 116′, of plain concrete, and was completed in 1869. The first plain concrete bridge built in the United States was the Prospect Park bridge in Brooklyn, built in 1871, with a 31′ span. In Golden Gate Park, San Francisco, was built, in 1889, the first reinforced concrete arch in this country.

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PLACING CONCRETE UNDER WATER.

Placing concrete under water is a particular job. Concrete should never be placed in running water. The danger is that the cement coating will be washed off the sand and gravel particles, leaving the mass without a binder. In under-water work, concrete is sometimes placed in bags, compacting the bags closely. In small work the mixture can be put in pails, boards placed over the pails, and when the bottom is reached, by turning the pails over, drawing the boards from beneath them and raising the receptacles, the concrete is allowed to flow out. Care should be taken not to disturb the water near the concrete.

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USE OF MANURE ON GREEN CONCRETE.

The practice of covering concrete work in cold weather with manure is not regarded as safe. Acids in the manure are injurious to green concrete, but have no effect on concrete that has thoroughly hardened.

* * *

PERFECT CONCRETE.

A man who has had long experience in the concrete business contributes the following "simplest and only positive rule for making the strongest possible concrete with the smallest needed quantity of cement:"

1. Fill with broken stone or gravel of the size expected to be used, a box containing (say) one cubic foot.

2. Turn into this, measured, the amount of water required to fill the voids, i.e., fill to the brim. This measured quantity of water will be the measured quantity of the sand to use, i.e., the proportion.

3. Put into the box the amount of dry stone required to fill it. Mix with it and thoroughly shake down the measured quantity of dry sand aforesaid, until the voids are filled. Turn in a measured quantity of water until the box is filled with the water. This measured quantity of water will be the amount (proportion) of dry measured cement to use. Thorough mixing of the wet concrete is obviously necessary for perfect results.

BOILER ARCH OF CONCRETE BLOCK.

Concrete boiler arches result in a saving of labor and a saving of fuel. The 125 h. p. boiler of the Livonia Light and Heat Co., Livonia, N. Y., was arched in with concrete block by the Livonia Cement Block Co. The contractors used three courses of 8″x6″x20″ smooth faced hollow block, thus allowing five airspaces for the entire arch.

*   *   *

CONCRETE BLACKBOARDS FOR SCHOOLS.

New uses for concrete are being found every day. School rooms throughout the Middle West are now being equipped with concrete blackboards, and many excellent points are claimed for boards of this material. It is said that they are waterproof and indestructible. Having no joints, they are sanitary. The surface has a dull gray color that avoids strong light reflection, and is rough enough to receive the chalk quietly, without consuming too much chalk.

The board consists of a concrete base, applied to brick walls or metal lath, before or after the building is completed, and faced with a wet concrete mixture that gives the desired surface. The board is not trowelled.

*   *   *

CRUDE PETROLEUM, FOR PREVENTING STICKING.

If the face-plates of a concrete block machine are lightly wiped with crude petroleum, the operation being repeated as often as it appears to be necessary, this will be found to prevent concrete from adhering to the plates.

*   *   *

OIL, EFFECT OF, ON CONCRETE.

It is generally felt that mineral oils, like petroleum, and so on, have little effect on concrete. Animal oils, like lard oil, and signal oil, a mixture of animal and mineral, sometimes have a superficial effect on the surface of concrete.

*   *   *

"FLOUR," ADVANTAGE OF, IN CEMENT.

It is generally conceded that the chief cementing work of Portland cement is done by the smallest particles, called "flour." These are 1-200 of an inch in diameter, or less.

*   *   *

WET MIXTURE ALWAYS PREFERABLE.

Good practice recommends that any concrete mixture shall be made as wet as possible, having in mind the necessity of manipulation.

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PLASTERING DIRECT ON CONCRETE BLOCK.

If the block in the wall are made of perfectly graded aggregates, good cement and plenty of water, and the concrete is thoroughly tamped to remove air-bubbles from the mass, it is perfectly safe to plaster directly on the inside face of the wall, without furring or lathing.

For wall construction, it is always wise to use some system of waterproofing in the concrete.

LAYING A CONCRETE FLOOR ON A WOODEN ONE.

First, go over the old floor carefully, nailing down any loose boards, cleaning the wood thoroughly and drenching it with water. On top of the cleaned floor, lay a layer of expanded metal fabric, fastening it down with staples and making a lap of about three inches at the edges. Over this, place the concrete floor. This should consist of a layer from 1½″ to 2½″ in thickness, made 1:3. The mixture should be rather wet, in order that it may be properly finished.

* * *

CINDERS NOT NEEDED IN SIDEWALK SUB-BASE.

Practical sidewalk builders are getting away from the idea that a thick layer of cinders is necessary in the construction of a good walk. All that is necessary is to see that the bottom of the excavation has no soft spots that will settle later, and that the surface is well rammed and compacted before the walk is laid.

* * *

COST OF CONCRETE, PER CUBIC YARD.

Following is a general table of expense in placing concrete for a pavement. The figures may vary more or less, according to the prices paid for labor and materials in different parts of the country, but in the main they are a fair average.

Cost of placing concrete in a 6″ pavement foundation. Cost below is for 45 cu. yds. per gang.

	Per day.	Per cu. yd.
4 men filling barrows with sand and stone ready for the mixers, wages 15c per hr	$ 6.00	$0.13
10 men wheeling, mixing and shoveling to place (3 or 4 steps), wages 15c	15.00	.33
2 men ramming, wages 15c per hr	3.00	.07
1 foreman, 30c per hr., and 1 water boy, 5c per hr	3.50	.08
Total	$27.50	$0.61

Organization of each of two gangs of men working under separate foremen, each man averaging 3 cu. yds. per 10-hr. day.

	Per day.	Per cu. yd.
4 men loading barrows	$ 6.00	$0.12
9 men mixing and placing	13.50	.27
2 men tamping	3.00	.06
1 foreman	2.50	.05
Total	$25.00	$0.50

* * *

SULPHUR CONTENT IN PORTLAND CEMENT.

Specifications for finished Portland cement place 1.75 per cent of sulphur (SO_3) as the maximum amount of sulphur allowable.

"Y" AND "T" JOINTS IN CONCRETE PIPE.

To make joints between two concrete pipe of different size: Select a good specimen of each size. Bed the larger one in sand, to keep it from rolling, and cut the smaller pipe so as to fit the outer shell of the larger pipe. Pipe two or three weeks old cut best and the pipe should be kept thoroughly wet while the cutting is going on.

Fit the cut pipe onto the side of the larger one and mark with a nail or a pencil the outline of the curve where the two pipe join. With a chisel, cut carefully along this line, cutting half way through the pipe. Now cut through from the inside in three or four places along the line, and tap the partially cut piece from the inside. Rim out the hole neatly and coat its edges and the cut edges of the smaller pipe with a cream-like solution of cement and water. Insert the smaller pipe in place, brace it in position, and seal the joint with cement mortar. The completed joint should be wiped with cement mortar, 1:2 sand.

* * *

CUBIC YARD OF CONCRETE, MATERIAL REQUIRED FOR.

The following table shows the materials required for one cubic yard of rammed concrete, using the mixtures indicated:

Mixtures.	Stone, 1″ and under, dust screened out.			Stone, 2½″ and under, dust screened out.		
1:2:4	1.46	.44	.89	1.48	.45	.90
1:3:5	1.11	.51	.85	1.14	.52	.87
1:2:3	1.70	.52	.77	1.73	.53	.79

Mixtures.	Stone, 2½″, with most small stone screened out.			Gravel, ¾″ and under.		
1:2:4	1.53	.47	.93	1.34	.41	.81
1:3:5	1.17	.54	.89	1.03	.47	.78
1:2:3	1.78	.54	.81	1.54	.47	.73

The following amounts of material are required for making a cubic yard of slush concrete, using No. 3 sand:

Mixtures.	Cement bbls.	No. 3 sand, cu. yds.
1:2	3.04	.92
1:3	2.21	1.01
1:4	1.72	1.05
1:5	1.41	1.08

* * *

TEMPERATURE RESISTED BY CONCRETE.

Portland cement leaves the kiln at a temperature of more than 2,800 degrees Fahrenheit. If the aggregate in concrete is chosen to resist high temperatures, there need be no fear that the cement will fail under fire.

MODELS, MATERIAL FOR MAKING.

It is often desired to make small objects in concrete for samples or for display purposes. A satisfactory mixture for this purpose consists of three parts marble dust, one part Portland cement, one part fine, clean sand and one part of plaster of Paris. The color can be lightened by using pure white sand and white Portland cement. If the objects are cast in wooden molds, wipe them off with creosote before using; if they are of iron, use vaseline. The surplus material should be wiped off the molds before the casting mixture is placed in them.

* * *

AIR-HOLES IN CONCRETE SURFACES.

When air-holes appear in the surface of concrete cast against a mold, there is an indication that the concrete has not been properly tamped. Thorough tamping is absolutely essential to securing good concrete and a smooth surface.

* * *

LAWN ROLLER OF CONCRETE.

A convenient lawn roller may be made of a straight concrete sewer pipe, 24″ or 26″ in diameter. Two cross-pieces of 2″x4″ wood are fitted to each end of the pipe, holes being drilled near the edges of the pipe to admit screws which will engage in the ends of the cross-pieces. A stout iron pipe or rod is run through holes bored in the intersection of the cross-pieces and the ends of the rod are attached to a yoke carried on a pole. An old lawn-mower handle answers admirably for the latter.

* * *

SEASHORE SAND, BAD FOR CONCRETE.

It is unwise to use sand from the seashore in concrete, unless it is first washed to free it from the salt. This regulation forms part of the government specifications for concrete work.

* * *

CRUDE CREOSOTE FOR WIPING MOLDS.

Crude creosote may be purchased from F. J. Lewis Mfg. Co., Moline, Ill.; Republic Chemical and Creosoting Co., Indianapolis, Ind., and U. S. Wood Preserving Co., 29 Broadway, New York City.

* * *

GRANITOID WORK FOR FLOORS AND BASES.

Granitoid work finds its place in making floors and baseboards. It is formed by mixing small particles of hard stone, like granite or marble, in the desired color, with a paste of Portland cement, sand and water. This mixture is ordinarily spread about two inches thick on a layer of cinders, and allowed to harden. The surface is afterwards smoothed and polished to bring out the color of the aggregate by using some heavy stone, set in a handle, pushing it to and fro until the film of cement is ground off and the aggregates exposed.

It is customary to divide granitoid floors into panels by laying a strip of wood, about ½″ wide and ⅜″ thick, at intervals, marking off the floor

into rectangles. These strips are removed after the concrete has set and their places filled by laying in pieces of stone, in color to contrast with the general color of the floor.

* * *

SAFE LOAD FOR POSTS.

The formula commonly accepted in practice is that the safe carrying capacity of a concrete post is equal to Ac Fc plus As m Fc. Ac equals the area of the concrete; Fc is the safe allowable compressive stress on the concrete, and As is the area of the steel reinforcements; m is the ratio of the moduli of elasticity of steel to concrete.

For 1:2:4 concrete, the value of Fc is ordinarily taken at 500 pounds. The ratio of moduli is 15. So the formula becomes: Safe carrying capacity equals 500 times Ac, plus 7,500 times As. Knowing the area of your concrete and the area of your steel reinforcement, you can readily substitute and secure the desired figures. All units for area should be in square inches and their fractions.

This formula applies in all cases in which the least horizontal dimension of the column is equal to or greater than 1-20 of the height. If the least horizontal dimension is smaller than this, the safe allowable stress must be accordingly decreased.

* * *

CAUSE OF PASTE FORMATION ON CONCRETE.

It sometimes happens that when concrete is placed there is a layer of pasty consistency that forms on top of it. This does not harden, but remains soft, like putty. The main body of the concrete hardens properly. This layer of soft material is caused by the presence of silt in the sand or other aggregates. Its presence is not injurious, but it should be carefully removed before any attempt is made to finish the surface. Where this condition is noted, it will be well to wash the sand before doing more work with it.

* * *

FLAT AND ARCHED BRIDGES OF CONCRETE.

Where the span of the proposed bridge is less than 40′, it is economy to build a flat, rather than an arched bridge. A beam 12″ wide and 16″ deep, placed every 6′ for the bed of the bridge, will be amply strong. Each beam should be reinforced with two 1¾″ and two ¾″ bars.

Between the beams, use a solid concrete slab, 4″ thick, reinforced with expanded metal, 6″ mesh. This should give a safe live load of 200 lbs. to the square foot, with a factor of safety of four.

* * *

EXCELSIOR CARBON BLACK FOR COLORING CONCRETE.

Excelsior carbon black, which can be secured from any large dealers in paints and oils, or any large chemical house, will be found useful for coloring concrete black.

ALKALI AND ITS DANGERS.

Alkali, in general, is any soluble salt that makes its appearance on the surface of concrete, when the latter is wet. Alkali varies greatly in its percentage content of the following salts: Sulphate of lime, magnesia, soda, alumina, iron and potash; carbonate of soda and potash; chloride of soda and nitrate of soda. Of these, it is the sulphates alone that prove injurious to concrete.

* * *

SMOOTHING A CONCRETE SURFACE.

Rubbing a concrete surface with a brick of carborundum will have the effect of removing all form-marks and other surface imperfections of irregularity.

* * *

APPARATUS FOR TESTING CEMENT.

Le Chatelier's specific gravity apparatus, Vicat's or Gillmore's needle test apparatus, small scales for weighing cement and graduated vessels for measuring it, may be obtained from Riehle Cement Testing Machine Co., 1424 North Ninth St., Philadelphia, Pa. Bausch & Lomb, Rochester, N. Y.; Eberbach & Sons, Ann Arbor, Mich., and Whitall-Tatum Co., 410 Race St., Philadelphia, Pa., are dealers in chemical glassware.

* * *

CHEMICAL SYMBOLS IN CEMENT AND CONCRETE.

The chemical signs most commonly used in speaking of Portland cement and concrete are: CaO, lime; $Si\ O_2$, silica; $Al_2\ O_3$, alumina.

* * *

NEWBERRY FORMULA FOR CEMENT.

S. B. Newberry, of the Sandusky Portland Cement Co., was the first man, so far as is known, to make a scientific formula covering the important contents of properly proportioned Portland cement. His experiments showed that the content of lime ought to be equal to 2.8 times the silica, plus 1.1 times the alumina.

This formula of course represents ideal laboratory conditions, seldom, if ever, obtainable in commercial practice. Under working conditions, the formula becomes more nearly this:

Carbonate of lime equals 4.8 times silica, plus 1.9 times alumina.

* * *

PORTLAND CEMENT MORTAR FOR MASONRY.

For a mortar with maximum adhesive and compressive strength, take one barrel of Portland cement (four sacks) and four barrels of clean, coarse sand, mixing them thoroughly, dry. Add water to bring the mass to the desired consistency and just before using add two pails of lime paste, which should be mixed with the mortar until the mass is thoroughly homogeneous.

SILICA SAND FOR RESISTING HIGH TEMPERATURES.

A sharp silica fire sand, used in furnace linings at the steel plants, is produced by Ballou's White Sand Co., Millington, Ill. It is of course well adapted for use in concrete construction designed specifically to resist the continued application of high temperatures.

* * *

SAND BLAST OUTFIT FOR CLEANING CONCRETE.

A tank of compressed air, kept full by an air-pump, a hose and a tool that permits a stream of hard silica or flint sand to be driven against the surface to be treated make up a sand blast outfit. It is of great use in cleaning an irregular surface of masonry. It is handled by the American Diamond Blast Co., 50 Church St., New York City, and the J. W. Paxon Co., 1015 N. Delaware Ave., Philadelphia, Pa.

* * *

CHALK, NATURAL LUMP.

Natural lump chalk may be obtained from Samuel H. French & Co., Fourth and Callowhill Sts., Philadelphia, Pa.

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GOVERNMENT LABORATORY FOR CEMENT.

Richard L. Humphrey is in charge of the laboratory maintained by the United States government at St. Louis, Mo., for making tests on cements and concretes. He should be addressed at Cement Pavilion, Exposition Grounds, St. Louis, Mo., or Harrison Bldg., Philadelphia, Pa.

* * *

ACETIC ACID AFFECTS CONCRETE.

Vinegar in an unfermented condition is quite inert in contact with concrete. After fermentation has proceeded and acetic acid has formed, there is an immediate reaction with the concrete, forming soluble acetates, with corresponding disintegration. Though one of the weakest acids, acetic acid is very violent in its action on hardened concrete.

There is no present known prevention for this action. Concrete tanks designed for containing vinegar should be lined with glass or some other material impervious to the action of acetic acid.

* * *

MATERIALS NECESSARY FOR PORTLAND CEMENT.

Essential materials for the manufacture of Portland cement are lime, silica and alumina. There are a number of materials in which these elements are found in nature. They may be briefly classed as follows: Calcareous materials, which include limestone, marl, chalk and alkali waste; and argillaceous materials, which include clay, shale, slate and blast furnace slag.

* * *

IMMERSION PROCESS FOR CURING CONCRETE.

As a general proposition, immersing concrete products in water does not cure them so satisfactorily as does the sprinkling process, or the application of exhaust steam for 48 hours.

PEBBLE-DASH FINISH.

Plaster used for pebble-dash or rough-cast finish of concrete is satisfactorily made of one part Portland cement and two parts of coarse, well graded sand. Before the plaster has thoroughly set, pebbles of the desired color and size are pressed into it, about half way.

* * *

PROTECTION OF METAL IN CONCRETE.

It is found that where metal has been properly embedded in concrete and removed after the lapse of many years, its surface is bright and free from rust, even though rust may have been present in small quantities at the time the concrete was placed about the metal. The concrete excludes air from the metal and protects it from disintegration.

* * *

TUCK-POINTING, MORTAR FOR.

Use three parts of hydrated lime, one part Portland cement and enough sharp sand to make a rich mortar. This mortar spreads easily under the trowel, and should not crack.

* * *

STEAM CURING OF CONCRETE PRODUCTS.

As a rule, concrete products are cured more rapidly and in a more satisfactory manner through the use of exhaust steam. Exposure to a thoroughly saturated atmosphere of steam for 48 hours produces a well-cured product.

Exhaust steam should be led into the bottom of a room that is not too high. Run pipes on the floor of the room, with ¼″ holes every 12″ to 16″ and let the exhaust steam envelop the products to be cured. If the room is too hot, the high temperature will rob the surface of the concrete of water and streaks will result. More or less experimenting must be done, but the results secured are worth all the intelligent trouble they take.

* * *

WASHING SAND, METHOD OF.

If sand is dirty, containing loam or clay, or other useless, soluble material, it must be washed before it will make good concrete. The simplest way to do this is to turn a hose on your sand heap. The water will wash away the dirt. Or, if you find that you have to wash a considerable quantity of sand it may be useful to put the sand in a box, not too tight at the bottom, and run water through the mass until the water comes out clean. Washing sand is worth all the trouble it takes, when the sand is dirty. (See Silt.)

* * *

VENEER BLOCK, ATTACHING TO BRICK WALL.

If it is thought to be desirable to attach a veneer of concrete block to a brick wall, the veneer may be secured to the wall by means of galvanized iron wall-ties, laid in the courses of the veneer block and in the courses of the brick. Rake out the mortar from the joints of the latter, at places opposite the courses in the veneer and cement the wall-ties into place with Portland cement plaster. (See Plaster, Portland Cement.)

CINDERS, USE OF, IN CONCRETE.

Cinders, where they are free from particles of unburned coal and from substances like sulphur, are satisfactory for use in concrete for fire-proofing purposes, but should never be used in any construction that is to bear any considerable weight. (See Sidewalks.)

* * *

SEA-WATER, DANGEROUS FOR CONCRETE.

Sea-water ought not to be used in concrete work. Danger arises from the formation of sulpho-aluminates, with resulting expansion and injury to the cohesive qualities of the concrete. The alumina contained in the cement itself is obviously responsible for the trouble and German manufacturers make a cement in which the alumina content is replaced by iron, for special use in sea-water.

* * *

PLASTER OF PARIS TO HASTEN THE SET OF CEMENT.

Gypsum, or plaster of Paris, is sometimes used by workers to make cement set more rapidly, but it is a poor practice and not to be encouraged. It will be found, to the surprise of the average man, that the addition of an amount of plaster of Paris as small as 2 per cent of the cement has the effect of slowing the set rather than accelerating it. Cement as it comes from the manufacturer should not be tampered with. The addition to it of various substances often has an effect quite contrary from what is expected or desired.

* * *

FACING, WHITE, COST OF.

J. Augustine Smith, of the Ideal Concrete Machinery Co., South Bend, Ind., estimates that the cost of white cement for an 8″x8″x16″ block is nearly 2¼c per block; for an 8″x8″x24″ block he figures that it is nearly 3⅜c. His computations are based on white cement at $5.00 per bbl.

* * *

SAND, WHITE, COST OF.

For a ½″ facing of 1:2 concrete on an 8″x8″x16″ block, made of white sand, the sand cost will be about 1c per block, and 1½c per block for an 8″x8″x24″ block.

* * *

MARBLE DUST, CARE IN THE USE OF.

Don't use too much marble dust. It results in hair-cracks and other surface disfigurements. The mixture that includes marble dust should use it in the proportion of 1½ parts of marble dust to 4 parts white sand.

* * *

STRENGTH, MAXIMUM, OF CONCRETE BLOCK.

Specifications of the National Association of Cement Users require that a concrete block shall show a minimum crushing strength of 1,000 lbs. per square inch of superficial area at the age of 28 days—concrete 1 cement, 3 sand, 4 gravel.

SIEVES FOR GRADING CEMENT.

A No. 10 cement screen carries ten meshes to the linear inch, or 100 meshes to the square inch, a No. 20 carries 400 to the square inch, and so on.

In ordinary practice of manufacture, makers of sieves or screens use No. 28 wire, Stubbs gauge, for a No. 20 screen; No. 31 wire for a No. 30, and No. 35 wire for a No. 50.

Standard specifications require that wire used in a No. 100 sieve shall be woven (not twilled) from brass wire, with a diameter of 0.0045 inches.

* * *

LAYING BLOCK, COST OF.

A fair estimate for laying concrete block is 5 cents per cubic foot, the block delivered on the scaffold or conveniently near the wall. This estimate is based on ordinary plain ashlar block.

* * *

STONE DUST, DANGER OF, IN CONCRETE.

If you want to avoid trouble, exclude the fine dust from screenings used in concrete. The dust particles are inert and absolutely without value, while they may be a source of real danger from weakness.

* * *

DANGEROUS ELEMENTS IN PORTLAND CEMENT MATERIAL.

In examining the raw material for the manufacture of Portland cement, be sure that it contains no sand. Even small quantities are highly objectionable. Magnesia, in quantities amounting to more than 8%, would justify rejection. Magnesia has no hydraulic properties.

Sulphate of lime, in proportions exceeding 2%, is considered injurious, since it is liable to reduction to sulphide, causing discoloration. Excess of alkalis, like potash and soda, are believed to be a cause of unsound cement.

* * *

TEST FOR ORGANIC SUBSTANCES IN MARL.

To test for organic substances in marl, weigh a quantity of marl, dry thoroughly and weigh again. The difference is the quantity of water contained. Calcine or burn thoroughly the remaining quantity and weigh again. The difference, or "loss on ignition," represents the quantity of combustible organic matter. The residue contains all that is valuable in cement manufacture.

* * *

IRON IN THE WATER, EFFECT OF.

Any considerable percentage of iron in the water used in the manufacture of concrete will have the effect of making the concrete a dark brown color, after exposure to the air for some time. There is no known method of altering this appearance, except to give the concrete a coat of paint of the desired color.

"JOPLIN GRAVEL" FOR CONCRETE.

"Joplin gravel," or the grits from lead mines, makes excellent material for use in concrete.

* * *

LUMBER AND CONCRETE IN COMBINATION.

As a general thing, any combination of lumber and concrete is unsatisfactory. The swelling of the lumber, as moisture is absorbed from the concrete, is unavoidable, unless the wood is protected with creosote, or several coats of good paint, and the tendency is to crack the concrete badly.

* * *

GRAVEL, DEFINITION OF.

Gravel is generally understood to be the material that is caught on a No. 20 sieve, and from that up to 1″ in diameter.

* * *

SAND, DEFINITION OF.

Sand is generally understood to be material that passes a No. 20 sieve and is caught on a No. 30.

* * *

WEIGHT OF A CUBIC FOOT OF CONCRETE.

A cubic foot of concrete weighs about 150 pounds, where gravel and crushed stone are used with the cement. The weight naturally varies slightly with the density of the block and the materials used.

* * *

EFFLORESCENCE, CAUSE OF.

Efflorescence, a white deposit on the surface of concrete, is the result of soluble portions of the aggregate working out to the air. The prevention of it lies in making the concrete dense by the use of carefully graded aggregates, plenty of water and thorough tamping. It may be removed by using a weak solution of hydrochloric (muriatic) acid, one part of acid to six or ten of water. The wash should be well rubbed into the pores of the concrete with a brush and should be rinsed off with clean water as soon as the efflorescence has disappeared.

* * *

WIRE FOR REINFORCEMENT.

Wire, unless it is well twisted, does not ordinarily form good reinforcing material, for the reason that it is likely to strip. Ordinary band iron or some form of corrugated bar is preferable.

* * *

SILICATE OF SODA (LIQUID GLASS).

Silicate of sola, sometimes called liquid glass, is used by some block makers to render their block waterproof. A solution is made with water, so strong that the water takes up all of the chemical that it will absorb. This is applied to the surface with a brush and well rubbed in. It answers the purpose very well.

BANK VAULT, FIREPROOF.

To make a bank vault, 10'x10'x10', and to have it fireproof, the walls should be at least 8" or 10" in thickness, and should be mixed fairly wet, in the following proportions:

Cement	.34 barrels
Sand	.41 cubic yards
Stone or gravel..............	.81 cubic yards

This mixture should be thoroughly tamped as it is placed. The concrete may be painted with liquid cement paint and then with a colored paint if desired.

* * *

BARN FOUNDATIONS.

Proportions of concrete for foundations should not be leaner than 1:3:6 and the stone should not exceed 1" or 1¼" in diameter.

* * *

WET STREAKS IN CONCRETE.

The commonest cause of wet streaks in concrete walks, etc., is improper mixing. Care should always be used in securing a homogeneous mixture before the concrete is placed.

* * *

CRUSHED STONE, DEFINITION OF.

Crushed stone is generally understood to be material with a diameter larger than 1". It may run as high as 3" in diameter for heavy work.

* * *

SHARP SAND, DEFINITION OF.

Sharp sand is composed of sharp grains, that is, those that have not been rounded by too long action of water.

* * *

CLAY IN CONCRETE.

Clay, fine, dead sand, even though siliceous, and other foreign material seriously retard the hardening of cement mortar and consequently affect concrete also.

Where the clay is in lumps it is impossible to obtain a good mixture without the most laborious and painstaking mixing process. A lump of clay means a weak spot in the concrete. Where the clay is so spread through the mass as to coat the sand grains, the cement has no opportunity to bond with the aggregate. While in the laboratory, small proportions of clay (say 5%) are found to increase the strength of mortar, it is much safer to avoid sand that contains clay for use in concrete.

* * *

INCREASES IN BULK OF CONCRETE.

Carefully kept records show that a 1:2:4 mix of concrete increases in bulk 26 per cent; 1:2:5 increases 18 per cent; 1:3:5 increases 30 per cent. With ideally graded concrete, there should, of course, be no perceptible increase in bulk after mixing, but under ordinary conditions a considerable increase is practically bound to be manifest.

CRYSTALS IN CEMENT PREVENTED BY FREEZING.

If green concrete is permitted to freeze, injury results from the fact that the delicate needles in which Portland cement crystallizes are destroyed before they have had chance to form completely. In spite of numerous reports of success with frozen and thawed concrete, it is most unwise to expose the fresh product to low temperatures.

* * *

GRAIN ELEVATORS OF CONCRETE.

Large grain elevators of concrete have been built by the Peavey Elevator Co., Duluth, Minn.; the Cleveland Grain Co., Champaign, Ill., and the Witherspoon-Englar Co., Contractors, Chicago, Ill.

* * *

HOW TO HASTEN THE SETTING OF CONCRETE.

Concrete mixed with all the elements, cement, aggregates and water, warmed a little, will set more rapidly than concrete mixed at the temperature of the surrounding air. In using this acceleration, the mixer and all other implements should be heated as well.

Chloride of calcium or chloride of barium in small quantities has the same effect. It is worth remembering that while a moist mix sets more rapidly than a wet mix, the wet mix is denser, more nearly waterproof and in general more satisfactory.

* * *

JAMB BLOCKS FOR WINDOWS.

When arranging for window casings, it is possible and convenient to use a jamb block, 2″ x 6″, placed in the middle, to allow for pockets to receive the sash-weights. If no weights are to be used, nail a strip to fit the end core of the block, filling in with mortar, and placing the nails at the joints of the block. All openings should, of course, be carefully sealed with mortar.

* * *

ROUGH-CAST FINISH. (SPLATTER DASH.)

For producing a pleasing finish on concrete that is roughened by the forms or by some other cause, rough-cast is useful. The treatment consists in trimming off all prominent defects and fins and then wetting the concrete surface thoroughly with clean water. A 1:2 mortar of cement and well-graded sand, not too coarse, is then made and applied by throwing it from a trowel or from a small broom made of twigs, standing two or three feet away. Not all of the mortar will stick at the first attempt, but enough will adhere to form a bond for the next application, and so on. The process is continued until an even surface is produced. It is possible to mark off the plastic surface into oblong forms or into geometric designs. Colored clay tiles are also sometimes pressed into the surface in ornamental designs over window and door openings.

* * *

HYDRATED LIME.

Hydrated lime is commercial lime subjected to the action of clean water until the lime is thoroughly slacked, the water afterwards being

driven off and the lime reduced to fine powder. Quick-lime in sizes of 1″ and under, is used and the water well stirred into it. The heat generated drives off the water, and the residue, if not sufficiently fine, is ground to powder.

* * *

SLOWING THE SET OF CEMENT.

The addition of 2 per cent hydrated lime, by weight, has the effect of slowing the set of a quick-setting cement.

* * *

HYDRATED LIME FOR WHITENING CONCRETE.

Replacing 25 per cent to $33\frac{1}{3}$ per cent of the cement in concrete with hydrated lime has the effect of making the concrete white and dense, with a uniform color, according to S. B. Newberry, an authority on cement and concrete.

* * *

SIDEWALK, LIFE OF A.

In the opinion of Albert Moyer, a cement expert, the life of a properly made and uniform concrete sidewalk is at least 100 years.

* * *

WET MIX, THE ADVANTAGES OF.

In making concrete block, it is best to have the mixture the consistency of fairly stiff jelly, so wet that it will just leave the face plates without sticking to them and stand without sagging.

* * *

JOISTS, HOW TO SUPPORT IN A BLOCK WALL.

The best method of supporting joists depends somewhat on the type of machine used in making the block for the wall. If a 16″ block is used, the joist block may be made full length on the face, taking 1″ out at each end from the inside, to a depth of 6″. The use of such a block brings the joists with their centers 16″ apart and each joist rests directly over the center bond of the block below. In such construction, joist hangers would not be necessary.

If larger block are used, make your joist block 6″ wide and 14″ long between the joists. This will bring one joist above the bond and the next over an end joint, which would be safe. If necessary, the joists may be anchored to the wall with light iron anchors.

* * *

FOUNDATIONS, NECESSITY FOR CARE IN.

Great care should be taken to make the foundations for a concrete block structure adequate for the work to be done. Many cases of checked block and other wall troubles may be traced directly to faults in the foundation.

* * *

SLABS OF CONCRETE FOR SIDEWALKS.

It is sometimes desirable, for one reason or another, to make sidewalks in slabs, laying them to line and level as if they were natural stone. Where

this is done, care should be exercised to see that the foundation is well bedded and stable and that proper expansion joints are left between the slabs of concrete.

* * *

"AGEING" CEMENT.

It is generally considered, particularly with imported cement, that it is not best to use the product when too fresh from the kilns. Under the American system of manufacture, with its tremendous output at individual plants, all cement is aged by storage before it reaches the consumer. Moreover, long-continued storage does not appear to be essential with cements made in this country. Certain government specifications call for a certificate that cement has been subjected to aeration or ageing before it leaves the factory.

* * *

CHLORIDE OF CALCIUM.

Chloride of calcium is a waste product of the ammonia-soda process and is run to waste in enormous quantities from the soda factories at Wyandotte, Mich., and in Detroit, Mich. There is also a large soda factory at Syracuse, N. Y. The salt has a great affinity for water and is kept in air-tight bottles or cans. It sells for a few cents a pound.

The effect of the salt is to quicken the setting of Portland cement, but only when used in considerable quantity. A 10 per cent or a 20 per cent solution is generally employed for this purpose and is said to quicken the setting greatly, without ill effect. It would probably have no effect on the time of setting in cement that had become slow-setting through storage.

* * *

LUMPS IN CEMENT.

It sometimes happens that cement that has been stored for some time, particularly that which has been in the bags at the bottom of high tiers, comes to the job with lumps in it, of varying size. These should be carefully reduced, either by hand or with the apparatus manufactured for that purpose, before the cement is used. Lumps that pass through the mixing process without being broken up render the concrete unfit for use, and the batch should be rejected. (See Storing Cement.)

* * *

CHURCH CONSTRUCTION IN CONCRETE.

Recent builders of churches in concrete are: Jens C. Petersen, Traverse City, Mich.; Wm. M. Kingsley, 1010 Rockefeller Bldg., Cleveland, O.; P. B. Miles Mfg. Co., Jackson, Mich.; Keystone Cement Block Co., Allentown, Pa.

* * *

RESISTANCE OF CONCRETE AND BRICK WALL COMPARED.

There is no comparison between the resistance offered by brick and concrete walls. Concrete block 28 days old have shown resistance to a pressure of 2,600 pounds to the square inch, which is far in excess of anything that can be shown by brick walls. Year-old block have resisted a pressure of 3,000 pounds to the square inch.

MORTAR, REMOVING FROM BLOCK.

Try a solution of muriatic acid (hydrochloric acid). Apply this with a short, stiff broom, or a stiff brush, and wash it off immediately. If this treatment does not succeed, you will have to resort to mechanical chipping and the use of a light sand-blast. The ease with which mortar is removed depends very largely on the amount of Portland cement in it. The more cement there is, the harder it is to remove.

* * *

POINTING MORTAR JOINTS IN CONCRETE WORK.

Any pointing of mortar joints planned for mortar containing any con siderable percentage of Portland cement will have to be done while the mortar is green. Owing to the rigidity of the material after it has hardened, it is almost impossible to make an impression on it after that stage has been reached.

* * *

SALT IN SAND, AVOIDANCE OF.

In doing concrete work with sand taken from the sea-beach, take care that the sand selected is secured from a point well above high tide and sufficiently far below the surface of the beach to admit of the salt being filtered out. Otherwise you will have trouble with the salt working out to the surface of the concrete and making a white stain. (See Efflorescence.)

* * *

AREA WAY, SIDEWALK OVER.

For a sidewalk over an areaway, 5′ wide, use a 4″ slab of concrete, with trussed bars ½″ x 1½″, spaced 16″ apart. The cement finish, which should be laid at the same time as the body, should be made of 1:2 concrete, mixed quite wet and laid about 1″ thick. For the body use 1:2:4 and have the crushed stone of such size that all of it will pass a ¾″ ring.

* * *

WEIGHT OF PORTLAND CEMENT.

The standard weight of Portland cement is 380 pounds to the barrel, made up of four sacks of 95 pounds each.

* * *

CHECKING, MAP-CRACKING, CRAZING, ETC.

These troubles arise from too much water in the surface finish, or from too much work with the trowel. When a rich mixture is troweled to any extent, the suction created by the tool draws particles of neat cement to the surface, where they dry. This often causes fine cracks, known by various names.

* * *

REPAIRING A SURFACE DAMAGED BY FROST.

Concrete surfaces damaged by the action of frost may occasionally be repaired by moistening the surface thoroughly and then applying to it, in a sort of rough-cast (which see) a mortar of one part of Portland cement and two parts of sand.

SIMPLE TEST FOR PORTLAND CEMENT.

Make pats, one of neat cement and water and one each in the proportions of 1:1, 1:2, 1:3, 1:4 and 1:5 of sand. Let them set two hours in the air, 24 hours in water and 48 hours again in the air. Break them and examine the fracture. Keep a few of them for ten days and a few for thirty days, examining their condition at the end of these periods. These pats should give you a good line on the quality of the cement tested. If you are still in doubt, submit samples to a testing laboratory.

* * *

"ROSENDALE" CEMENT.

"Rosendale" cement is a natural cement, made from the rock in the so-called Rosendale district, New York state. It is not so strong as Portland cement, and is little adapted for concrete work, except below the level of the ground, for rough work.

* * *

GYPSUM, USE OF, IN PORTLAND CEMENT.

Gypsum is used by practically all manufacturers of Portland cement as an ingredient of the product. It is added for the purpose of slowing the time of setting, and may be used either before or after the cement is ground. A cement mill with a capacity of 1,000 barrels a day will use about four tons of gypsum for this amount.

* * *

RUST, ABSENCE OF, IN REINFORCING MATERIAL.

Experiments tend to show that reinforcing material, does not suffer deterioration from rust. Numerous cases are on record in which iron or steel that was rusted when placed in the concrete has been found on subsequent investigation to be bright and clean.

* * *

COATING MOLD. TO PREVENT STICKING.

Coating molds with linseed oil or painting them with liquid asphalt, dissolved in turpentine or benzine, afterwards coating with a soap solution, will prevent concrete from sticking to plaster of paris or wood molds. After treatment, the molds should be wiped off, lightly.

* * *

CONCRETE WASH FOR SURFACE OF BLOCK.

Some success in securing an impervious coating has been obtained by applying a wash of neat cement and water, mixed to the consistency of thin cream, to the surface of the block. The block should be well moistened before the application is made and the wash should be well rubbed into the pores, using a wide, stiff brush for the purpose.

* * *

BRICK AS AGGREGATE FOR CONCRETE.

If brick are hard-burned and crushed in such a way that the pieces are well graded in size, they may be used for foundations where no very heavy weight is to be borne. The largest pieces ought not to exceed a diameter of 2″ for satisfactory use. A mixture of one part of cement, two and one-half of well-graded sand and five of broken brick is about right.

CRUSHER RUN, WHAT TO WATCH IN.

In using crusher run stone or other aggregate, see that it is free from the very fine particles, which are inert in a concrete mixture. They are sure to give trouble in concrete.

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CUBIC CONTENTS OF A BARREL, IN INCHES.

To find the cubic contents of any barrel, find the average diameter of the barrel and divide it by two, to get the radius. Use the radius found to represent "r" in the formula, 2 pi r^2, where "pi" equals 3.1416. Suppose that your barrel has an average diameter of 18 inches. Its radius is 9 inches and the square of 9 is 81. This, multiplied by 3.1416, gives 254.4696. If the barrel is 30 inches in height, there will be as many cubic inches in it as the product of 254.4696 by 30, or 7,634.088 cubic inches.

Another way is to take the weight of a cubic foot of cement at 100 pounds (the usual weight). There are 380 pounds in a barrel of Portland cement, or 3.8 cubic feet. Since there are 1,728 cubic inches in one cubic foot, the cubic inches in this case would be the product of 3.8 and 1,728, or 7,566.4 cubic inches.

* * *

MIXING AGGREGATE FOR CONCRETE.

It is good practice to mix all your materials in the manufacture of concrete dry, later adding water until the desired consistency is obtained.

* * *

IDEAL CONCRETE.

The ideal condition in concrete is obtained when the aggregate is so well graded in size that the smaller particles completely fill the voids between the larger particles of aggregate and the particles of cement completely fill the voids between the smallest elements in the aggregate. There is little question that in the process of crystallization there is a certain amount of expansion, but as the ideal condition is not obtainable in ordinary practice the amount of expansion from this cause in a wet mixture is practically negligible. Theoretically, the cement takes up all the water in the process of crystallization.

* * *

MORTAR FOR CONCRETE BLOCK.

Use a mortar of one part of Portland cement to $\frac{1}{4}$ part slacked lime, and $3\frac{1}{2}$ parts of sand. The cement and sand should be thoroughly mixed together, dry, and then the slacked lime added. Small batches only should be made, especially in summer, for the mortar dries rapidly and when it has once set it cannot be tempered like lime mortar. For work in the late fall or early spring, it is better to omit the slacked lime entirely, using one part of cement and three of sand. The mortar must be made rather wet, so that it will spread well.

JOISTS, METHOD OF LAYING.

In a double-wall house, where each section of the wall is 4″ thick, it is perfectly safe to lay joists on the inner section, if a bearing of full 4″ is secured and the joists are so placed that they bear on the solid web of the block. Joist hangers should not be necessary in such a case.

* * *

WHITE PORTLAND CEMENT.

American-made white Portland cement is manufactured by the Sandusky Portland Cement Co., Sandusky, O., and by the Art Portland Cement Co., Kimmell, Ind.

* * *

STEPS OF CONCRETE.

A short flight of steps for ordinary use, not requiring reinforcement, may readily be made by using two forms, cut like the sides of the flight, and building up the steps with a foundation of well-tamped cinders. The concrete should be about 3″ thick, faced with a 1:2 mixture of cement and medium sand.

* * *

FROST, IMMUNITY FROM.

Concrete, if properly cured, should be immune from damage by frost within 48 hours.

* * *

COVE BASE OF CONCRETE, DIRECTIONS FOR MAKING.

For the mixture, use one part of cement and two parts of fine, graded sand, damp, but not wet enough to be sticky. Make forms for face and edges and fill face-down. Trowel back and insert wooden plugs for screw-holes. Also, insert a ¼″ iron rod in the center of the heaviest part. Clamp 2″ plank pallet firmly to the mold, turn it over and remove. Slide pallet back to place.

Benches for curing should be close enough together so that the pallet will not spring, and the pallets should not be lifted, but should be slid back on the benches. Benches for molding should be narrow and the same height as the curing benches, but not connected, so that the finished stone will not be jarred. By the above method, any length of cove base, up to 16′, may be made.

* * *

UNDERWRITERS' LABORATORIES.

The Underwriters' Laboratories are located at 382 Ohio St., Chicago, Ill.

* * *

CULVERT OF CONCRETE, FOR COUNTRY ROAD.

A culvert 3′x3′ and from 16′ to 18′ long is most economically made with a square opening, owing to the simpler nature of the forms required. Somewhat more material is required for the square type. Make the top and sides of concrete 6″ thick, reinforced with ½″ bars, spaced 12″ center to center. Such a culvert will carry with safety a 15-ton road roller.

SIDEWALK CONSTRUCTION.

For a complete treatise on this subject, see the booklet published by the Concrete Publishing Co., Detroit, Mich. It retails at 25 cents and is worth the price.

* * *

CINDERS, USE OF, IN CONCRETE.

Cinders that have been exposed to the weather for some time without signs of disintegration are permitted in light wall construction. For filling in panels that have no weight to bear and for fireproofing, cinder concrete is valuable. It should not be used where the concrete is called upon to bear compression. Be sure that the cinders are free from unburned coal, and from sulphur.

* * *

SPINDLES, SPACING, FOR PORCHES AND BALUSTRADES.

Spindles and similar ornaments should be spaced center to center a distance equal to twice their diameter. For example, spindles that are 5″ across the bottom should be spaced 10″ center to center. This will give a distance between adjacent edges equal to the diameter, which makes for the best appearance.

* * *

ICE HOUSE, WALLS FOR.

A hollow-wall construction, with a dead air-space between the portions of the wall, is very satisfactory for ordinary ice house construction. It is easily and quickly erected, either with any one of the two-piece wall constructions on the market, or with a hollow monolithic wall.

* * *

CRACKS IN CONCRETE, REPAIR OF.

It sometimes happens that through carelessness cracks develop in a concrete roof. A mixture of one part of coal-tar and two parts of Portland cement, boiled together and applied while hot, will be found an excellent means of closing them.

* * *

LEAKS IN TIN ROOF, REPAIR FOR.

A wash made of neat cement and water, mixed to the consistency of thin cream and brushed on the surface of a tin roof, is often found to be of value in stopping leaks. This treatment is of particular value in repairing tin or sheet metal gutters that have developed leaks.

* * *

SHORT TESTS FOR SAND.

Rubbing the sand between the palms, using considerable pressure, will give a good idea of the character of the grains, which should be sharp, not rounded. The grains should vary in size, from fine to coarse, and too many fine particles are undesirable. If the sand stains the hands, it should be regarded with suspicion. Throwing a handful of it into water and letting it stand for an hour or two will give a good idea of the amount of foreign matter in it. The best practice requires that sand shall be "suitable silicious material, passing a one-quarter inch sieve, clean, gritty and free from impurities."

FIRE-BOXES OF CONCRETE.

A 1:2:4 mixture of Portland cement, well-graded sand and gravel or crushed stone, not bigger than ¾″, will make concrete for a fire-box. Use plenty of water in the concrete and do not be afraid to tamp thoroughly. The concrete should be carefully cured and allowed to age before it is exposed to the heat of the fire.

* * *

LAYING CONCRETE BLOCK.

The best modern practice in the matter of mortar seems to include the use of hydraulic lime in the following mixture: Three (3) parts of lime, one (1) part of Portland cement and enough sharp sand to make a rich mortar. This spreads well and works easily under the trowel.

It should be remembered that it is necessary in all cases to moisten the block thoroughly before laying them in the wall. This will prevent surface absorption from the mortar and subsequent lack of adhesion.

Numerous methods have been devised for assisting the block-layer in performing his work accurately. On account of the cores and the necessity of keeping them free from mortar, metal or wooden plates are sometimes used to insure the proper disposition of the mortar.

Good practice recommends the use of a joint, ranging in width from one-quarter (¼) to three-eighths (⅜) of an inch.

Nothing is more erroneous than to suppose that any man can lay concrete block true and level and make a good job. The employment of men of good, average intelligence, under the real superintendence of a competent foreman, will be found an economical matter in the construction of concrete block work.

* * *

CAST STONE.

With a plaster or a wood pattern, embedded in sand in the ordinary manner, any number of casts may be made. Where there are no undercuts, the pattern is of course readily withdrawn from the sand. With shallow undercuts only, these are best cut in the stone when the latter is fresh from the sand. With deep undercuts, the pattern may be jointed, so that the undercuts may be withdrawn separately, after the main body of the pattern has left the mold. This is the method followed in most of the cast stone factories.

Concrete stone, cast from a mixture of fine stone dust and cement, with sufficient water to make the mixture the consistency of cream, is very attractive. Molds of fine sand, mixed with a suitable quantity of powdered talc or soapstone, are ordinarily used in connection with this process.

* * *

RUBBLE CONCRETE.

Rubble concrete is concrete in which comparatively large, unbroken stones, taken at random, form the aggregate and are cemented together with a thin grout. It is extensively used as a masonry filling, for example between two retaining walls or in similar situations. It is of course not so good nor so strong as concrete in which the aggregate is more carefully graded.

AGGREGATE, DEFINITION OF.

Aggregate is the material that forms the body of concrete, like sand, gravel, broken stone, cinders, brick, and so on. It is cemented together into a homogeneous mass by the addition of Portland cement.

* * *

PAINTING CONCRETE WORK.

It is not satisfactory to use ordinary paint on a concrete surface. Special preparations, compounded by men of long experience in the concrete business, give much more lasting and satisfactory service.

* * *

ROUGHENING A CONCRETE SURFACE.

If for any reason it becomes necessary or desirable to roughen a concrete surface, like that of a barn floor, this object is best accomplished by the use of the bush-hammer or bush-axe. This tool carries on its striking face several rows of hardened points, by means of which the concrete is chipped.

* * *

PRESSURE ON THE WALLS OF A TANK.

The unit pressure at any point of a tank containing liquid is the depth of that point in feet from the top of the surface of the liquid, multiplied by the weight of the liquid in pounds per cubic foot. In the case of water, which weighs about 62½ pounds per cubic foot, the pressure at the depth of ten feet is 625 pounds per square foot. The pressure varies from zero at the top to a maximum at the bottom.

* * *

COST OF CONCRETE BLOCK.

It is generally thought that a finished block, 16″x8″x8″, ought to cost about 15 cents, delivered at the building site.

* * *

"WOOD STONE."

This is a name given to a composition plastic flooring, used in place of tile and linoleum in bath rooms, lobbies, vestibules, kitchens, etc.

* * *

ACCELERATED TEST OF CEMENT.

A test for soundness of cement, made by subjecting a specimen to heat, either dry or from hot or boiling water. Results may be obtained in a few hours.

* * *

CENTERING.

Centering is the name given to the forms which hold concrete in place and shape until it has set.

* * *

CRAZING.

Crazing is one of the many names given to a condition characterized by small, fine cracks in the surface of concrete. It is usually caused by too rich a mixture—sometimes by unsound cement. (See Map-Cracks.)

CRUSHER RUN.

Crusher run is the name given to crushed gravel or stone as it comes from the crusher, without having any of the fine material, dust or "flour," screened out. It is not suited for the best concrete work.

* * *

EXPANSION JOINTS.

Expansion joints should be provided in flat surfaces, like sidewalks or floors. They are provided in order to allow for the expansion of concrete under differing temperatures. In making them see that they pass through the two coats of the concrete work down to the foundation, and that they are kept clear until the concrete has hardened. Otherwise, they will fail of their purpose.

* * *

FINAL SET OF CEMENT.

Cement is said to have reached its final set when a pat made of neat cement and water will resist the pressure of the thumb-nail without indentation. It is the stage which immediately precedes the hardening process.

* * *

FLUSHING CONCRETE.

Concrete is said to be flushed when water is brought to its surface by ramming or tamping.

* * *

GRAPPIERS CEMENT.

The French make a cement by grinding the particles that have escaped disintegration in the manufacture of hydraulic lime. This is called Grappiers cement.

* * *

GROUT.

A thin mortar, composed of cement, sand and water. It is either poured, as in the case of making rubble concrete, or applied with a brush in the form of a wash, to waterproof a concrete surface or to finish it.

* * *

HYDRAULIC CEMENT.

Any cement that sets or hardens in the presence of water is called hydraulic cement.

* * *

LAITANCE.

We have borrowed this word from the French language. It is used to designate the pulpy, gelatinous fluid that comes from cement deposited in water.

* * *

NATURAL CEMENT.

Clay-bearing limestone, heated to such an extent as to drive off the carbonic acid gas present, and finely ground, is designated as natural cement.

It is less well adapted to concrete work than Portland cement, but has its uses in construction under ground and in other works not called upon to develop much resistance to pressure.

* * *

NEAT CEMENT.

A mixture containing Portland cement and water only, is known as neat cement. (See Cement Paste.)

* * *

PORTLAND CEMENT.

A properly proportioned mixture of lime and clay, heated to incipient fusion and finely ground, is known as Portland cement. The name comes from the fact that the first cement was thought to resemble the stone taken from the famous Portland quarries, in England. The chief ingredient of Portland cement is lime, which constitutes from 58 to 67 per cent of the total, the amount depending upon the relative proportions of silica and alumina. Silica forms from 19 to 25 per cent of the whole and alumina between 5 and 10 per cent.

The Newberry formula for Portland cement provides that the per cent of lime shall equal the per cent of silica multiplied by 2.8, plus the per cent of alumina multiplied by 1.1.

* * *

PUDDLING.

The process of stirring concrete, when it is too wet to be tamped or rammed, is known as puddling.

* * *

PUZZOLAN CEMENT.

Granulated furnace slag, ground with slaked lime to a fine powder, is called Puzzolan cement. It possesses hydraulic properties to a large extent.

* * *

SET OF CEMENT.

Cement is said to have set when a needle 0.039 inches in diameter and weighing 10.58 ounces (the Vicat apparatus) penetrates only .20 inches into the mortar. The set is complete when the needle will not penetrate. Roughly speaking, the set is present when cement paste resists a light pressure of the finger nail. (See Final Set.)

* * *

VASSY CEMENT.

This is the name given to a cement made by heating limestone containing much clay at the lowest temperature that will decarbonate the lime. Such a cement sets very rapidly, but hardens slowly.

* * *

SCREEDS.

Levels used for guides and bearings for leveling and ruling off are known as screeds.

CHATS.

Particles of hard gravel or crushed stone are known as "chats" in some parts of the country.

* * *

PORTLAND CEMENT, DEFINITION OF.

The standard specifications of the American Society for Testing Materials define Portland cement as "the finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous (clay) and calcareous (lime) materials, to which no addition greater than 3% has been made subsequent to calcination."

* * *

COMPARATIVE WEIGHT OF A BARREL OF PORTLAND AND NATURAL CEMENT.

A barrel of Portland cement contains 380 pounds, net, of cement, and weighs about 400 pounds. A barrel of eastern natural hydraulic cement weighs about 320 pounds gross and should contain 300 pounds net of cement. A carload of Portland cement usually means 100 barrels, 40,000 pounds; 75 barrels is the minimum carload.

* * *

WASH FOR REMOVING EFFLORESCENCE.

The best method of removing efflorescence from the face of concrete is to apply to the surface a solution of sulphuric or hydrochloric (muriatic) acid, in the proportion of one part of acid to six to ten parts of water. The concrete should be thoroughly scrubbed with the wash and should afterwards be flooded with clean water, in order to remove all trace of the acid from the work. (See Efflorescence.)

* * *

VOIDS, SIMPLE TEST FOR PERCENTAGE OF.

To determine the percentage of voids in any mixture of aggregates, all the ingredients should first be thoroughly moistened, so that subsequent absorption may not affect the result. Then fill a receptacle of known capacity with the mixture to be tested and pour from a vessel of known capacity sufficient water to fill all voids. The required amount of sand is represented by the amount of water required to fill the voids.

* * *

FUEL REQUIRED FOR A BARREL OF PORTLAND CEMENT.

Every barrel (380 pounds) of Portland cement requires at least 200 or 300 pounds of coal for fuel in its manufacture. The fuel charge is from 30% to 40% of the total cost of the cement.

* * *

STORING CEMENT.

Much care should be exercised in storing cement. Select a storage place that is thoroughly dry and as an additional precaution store the cement on a platform, raised six or eight inches from the floor, and away from the walls. Cement in wooden barrels or in paper ordinarily keeps better than when packed in cloth.

If the cement is stored to any considerable height, the cement in the lower layers of bags sometimes become hard from compression, but no harm results from this. (See Lumps in Cement.)

* * *

ICE HOUSE CONSTRUCTION OF CONCRETE.

A double wall with an air-space answers admirably for ice house construction. Such a wall may be very conveniently built with any one of the numerous systems of two-piece hollow wall block construction, and there is then no necessity for forms.

* * *

QUICK-SETTING CONCRETE, DANGER IN.

Many workers in concrete ask for some method by which concrete can be made to dry out quickly, at the same time setting free from cracks. While there are a number of means of hastening the set of concrete, it is as a general thing unwise to use them. The old-fashioned, reliable method of keeping the concrete moist until it has achieved its natural set is the one that secures the most satisfactory results, or curing by steam is good.

* * *

WAINSCOTING OF CONCRETE.

A simple and satisfactory method of wainscoting with concrete is to apply metal mesh fabric, about 6″ for the mesh, to the wall at the point to which it is desired to extend the wainscoting. On this is plastered a mortar composed of one part of Portland cement and two parts of fine, sharp sand. If this is properly finished, it gives a pleasing surface and one that can, if desired, afterwards be treated with paint or other decorative covering.

* * *

DISCOLORATION, REMOVAL OF, FROM CONCRETE.

When concrete block or other concrete products are discolored as a result of smoke, soot and similar impurities, it is sometimes possible to remove the accumulations by applying naptha. If this fails, a light application of the sand-blast will entirely remove the discolored surface. (See Sand-Blast.)

* * *

MARL AND ROCK, RELATIVE VALUE OF, FOR PORTLAND CEMENT.

There should be no difference in the quality of cement made from marl or limestone. Under the present conditions of manufacture, requirements for Portland cement are absolutely uniform and, provided the constituents are properly proportioned, it should make no difference whether marl or rock is used.

* * *

DAMAGED CEMENT, AVAILABILITY OF.

It sometimes happens that cement is stored in non-fireproof buildings and that the building is burned. Where water and chemicals touch the cement, there is formed a hard shell, about ½″ thick. Inside of this shell, the cement ordinarily remains unharmed and is fit for use.

CLEANING MORTAR FROM CONCRETE.

When concrete has been smeared with mortar containing any very great percentage of Portland cement, it is a difficult matter to clean the mortar off. It would be difficult to limit the action of any acid sufficiently concentrated to have any effect, to the mortar alone. Mechanical chipping, followed by a light sand-blast, will do the work. (See Sand Blast.)

* * *

AMOUNT OF CONCRETE IN A TWO-BAG BATCH.

The amount of concrete resulting from a two-bag batch, using sand and gravel mixed as they come from the bank, is indicated in the following table, prepared by the Association of American Portland Cement Manufacturers:

	Proportions by Parts.		Two-bag Batch for Natural Mixture of Bank Sand and Gravel.				
			Materials.			Size of Measuring Boxes.	
	Cement.	Natural Mixture of Sand and Gravel.	Cement.	Natural Mixture of Sand and Gravel.	Concrete.	Mixture of Sand and Gravel.	Water in Gallons for Medium Wet Mixture.
			Bags	Cu. ft.	Cu. ft		Gallons
1:2:4 Concrete....	1	4	2	7½	8½	2'x4'x11½"	10
1:3:6 Concrete....	1	6	2	11½	12	3'x4'x11½"	13½

* * *

WAINSCOTING FOR BATHROOM WALLS.

The use of patent plasters for bathroom decoration may be avoided and a permanent wainscoting secured by tacking expanded metal or wire mesh to the walls and applying two coats of concrete stucco of the proportions mentioned in the specifications for elevator shaft linings. The second coat should be of white Portland cement and white sand or white marble screenings. The surface should be gone over with a wood float and afterward with a plasterer's steel towel until a perfectly smooth finish is secured. Keep the walls wet for a few days and cover with dampened cloths for a week or more.

* * *

WATER, WEIGHT OF.

One gallon of water, weighs $8\frac{1}{3}$ pounds and contains 231 cubic inches. A cubic foot of water contains 7½ gallons, or 1728 cubic inches, and weighs 62½ pounds.

AREA COVERED BY CONCRETE STUCCO.

In using concrete mixtures as plaster for brick or stone walls, or for use on expanded metal or wire mesh, the following table showing the area covered by a batch of one barrel of Portland cement mortar (3.8 cu. ft. cement-paste), with no lime, may come in handy:

Composition of Mortar.	Thickness of Coat.	Square Feet of Area Covered.
	1 inch	67
1 Cement, 1 Sand.........	¾ inch	90
	½ inch	134
	1 inch	104
1 Cement, 2 Sand.........	¾ inch	139
	½ inch	208
	1 inch	140
1 Cement, 3 Sand.........	¾ inch	187
	½ inch	280

* * *

COMPARATIVE STRENGTH OF BRICK AND CONCRETE WALLS.

Tests at the Watertown, Mass., arsenal upon brick piers about eighteen months old indicate an ultimate carrying capacity ranging from 800 to 2,400 pounds per square inch. The results for brick laid with lime mortar average nearer the lower figure and those laid in a 1:2 Portland cement mortar reach the higher one. Tests of concrete block with a one-third air-space, made 1:3 and of simply moist consistency, show an ultimate compressive strength of 1,300 pounds per square inch, under test. Concrete block made in accordance with the standard specifications of the National Association of Cement Users will, we believe, show an ultimate compressive strength of from 1,200 to 1,500 pounds per square inch. This is materially better than the compressive strength of average brick work.

* * *

HAIR CRACKS, CRAZING, MAP CRACKS, ETC.

Albert Moyer, who has made a close study of cement and concrete, gives some valuable data on the cause of formation of minute cracks in the surface of concrete. While these cracks do not penetrate to any depth in the mass of the concrete, and while they are not necessarily injurious, they are a disfigurement. Mr. Moyer ascribes their presence to the fact that in a wet mixture of concrete, a portion of the "flour," or finest particles of cement used in the concrete, is carried to the surface, where they form a mortar richer than that in the body of the concrete. The particles, in fact, form practically a coating of neat cement.

It is known that neat cement concrete, cured in the air, crazes or cracks. This is noted in laboratory work, where pats of neat cement and water are made and allowed to set and harden in air. On the other hand, when they are protected in a moist closet and afterwards immensed in water for a period of at least twenty-eight days, no cracking results. Mr. Moyer states that neat Portland cement mortar, hardened in air, shows a .15 per cent contraction at the end of sixteen weeks; a 1:3 mortar, under the same conditions, shows a .05 per cent contraction, or only 1-3 the contraction

of the neat cement and water. Neat Portland cement mortar, hardened under water, shows an expansion of .05 per cent at the end of sixteen weeks; a 1:3 mortar, under the same conditions, shows an expansion of .015 per cent only.

With a knowledge of these conditions, the obvious thing to do, is to avoid the use of too wet a mixture, or manipulating the surface too much, as tending to develop a surface too rich in cement; and, above all, to keep the surface of curing concrete thoroughly wet. On flat surfaces, this may be secured by covering the concrete with wet sand, which must be sprinkled from time to time. For perpendicular surfaces, wet cloths should be hung over them, keeping the exterior wet and the cloths wet, also, by sprinkling. The thing to bear in mind is that you must reproduce as closely as possible the conditions under which concrete is cured in a moist closet or under water.

* * *

COMPARATIVE STRENGTH OF CONCRETE AND OTHER MATERIALS.

Crushing strength, cubic inch, concrete, about 2,246 pounds; granite, 187 pounds; marble, 124 pounds; limestone, 108 pounds; sandstone, 94 pounds; brick, 116 pounds.

Tensile strength, one square inch, concrete, 385 pounds; granite, 186 pounds; marble, 198 pounds; limestone, 165 pounds; sandstone, 94 pounds; brick, 137 pounds.

Weight, one cubic foot of concrete (average), 154 pounds; granite, 184 pounds; marble, 170 pounds; limestone, 148 pounds; sandstone, 140 pounds; brick wall, 130 pounds.

Fire test, concrete, 2100° Fahrenheit; granite, 670; marble, 900; limestone, 560; sandstone, 1400; brick, 1700.

* * *

SAND, SPECIFICATIONS FOR.

Good specifications for sand require that sand shall be "suitable, silicious material, passing the ¼ inch sieve, clean, gritty and free from impurities."

* * *

GRAVEL AND BROKEN STONE, SPECIFICATIONS FOR.

The N. A. C. U. requirements for coarse aggregate in concrete block are that "This material shall be clean, broken stone, free from dust, or clean, screened gravel, passing the ¾ inch mesh sieve and refused by the ¼ inch mesh sieve."

* * *

WATER, SPECIFICATIONS FOR.

Water, for concrete work, must be clean, free from oil, sulphuric acid and strong alkalis. It must also be free from iron or other impurities that tend to discolor the concrete.

* * *

COLORS FOR CONCRETE.

From 1 to 3 per cent of dry mineral color, added to the cement before mixing, will give a fairly permanent tint. The following proportions are suggested, the amounts named being added to 100 pounds of cement:

Black, 2 pounds Excelsior carbon black. (See Excelsior carbon black.)
Blue or green, 5 to 6 pounds ultramarine.
Brown, 6 pounds roasted iron oxide.
Gray, 8 ounces of lampblack.
Red, 6 to 10 pounds raw iron oxide.
Yellow or buff, 6 to 10 pounds yellow ochre.

* * *

MORTAR FOR LAYING CONCRETE BLOCK.

The best modern practice in making a mortar for laying concrete block suggests the use of hydrated lime, as follows: Three parts hydrated lime, 1 part Portland cement and enough sand to make a rich mortar. This spreads well and works easily under the trowel.

* * *

MORTAR JOINTS, THICKNESS OF.

Good practice recommends that mortar joints in block-laying shall be between $\frac{1}{4}''$ and $\frac{3}{8}''$.

* * *

HYDRATED LIME, ON SURFACES.

Sidewalk workers often sprinkle thoroughly slacked, finely ground lime on the surface of the walk before it has begun to harden. This delays the set a trifle and tends to produce a good color effect. The walk will be lighter in color and will shed water better.

* * *

IDEAL SAND AND AGGREGATE.

It is fairly obvious that the most nearly perfect concrete results when all the aggregates, from coarse to fine, are so chosen that the voids between the larger particles are exactly filled by the particles next smaller in size, these in turn being exactly filled by the particles next smaller in size—and so on, down to the point at which the voids between the finest particles of aggregate are exactly filled by the particles of cement. This condition may be closely approximated by grading the aggregate according to the granularmetric analysis, by means of which a graphic showing is made of the exact percentages of sand of a given size, passing standard sieves of a known mesh opening, that are required to make voidless concrete. The aim in the manufacture of concrete is to see that every grain of sand is completely covered with a thin film of neat cement and water. The neat cement and water, upon proper crystallization, bond together the particles of sand into a tenacious mortar; this in turn bonds together the next largest particles of aggregate, and so on, until the largest particles of the mass are firmly embedded in a matrix of mortar.

* * *

CRYSTALLIZATION OF PORTLAND CEMENT.

No man knows exactly, yet, why Portland cement hardens under water. About all that we do know is that it does, and how it does it. Microscopic examinations of Portland cement and water that have hardened show that the crystals formed are spicules, or needle-shaped crystals.

These needles interlace when crystallization is perfected and form a closely locked mass of crystals.

* * *

BOND OF CONCRETE AND STEEL.

The strong adhesion between reinforcing steel and concrete is due to the penetration of the microscopic pores of the metal by the spicules of crystallization formed by Portland cement and water. This bond is surprisingly strong. The contraction of the concrete, when it has hardened, about the metal, makes it practically impossible to withdraw the latter from the grip of the concrete, even though such force is used as to deform the bar.

* * *

DIVIDING PLATES FOR SIDEWALK EXPANSION JOINTS.

There are at the present time several devices upon the market for saving time and labor in the matter of securing absolute expansion joints in sidewalk construction. These devices, for the most part, provide for molding the walk with a ¼″ joint between slabs, the joint being formed by metal plates of the proper thickness and width, running between and at right angles to the 2″ x 4″ strips staked at the edges of the walk. When the concrete in the slabs has begun to set, the plates are withdrawn, leaving an open joint.

* * *

LAYING CONCRETE BLOCK.

Concrete block should always be thoroughly moistened before they are laid in the wall. This will prevent surface absorption of water from the mortar, and subsequent lack of adhesion.

* * *

SULPHURIC ACID IN CEMENT.

Standard specifications in this country limit the amount of sulphuric acid allowable in Portland cement to 1.75 per cent.

* * *

FINE SAND, TO BE AVOIDED.

For a number of excellent reasons, fine sand ought to be avoided in the manufacture of concrete. If the particles of sand are so fine as to approximate the sizes of the cement, there is trouble. Not more than 6 per cent of the sand used should pass a sieve having 100 meshes to the linear inch.

* * *

PORTLAND CEMENT, NEAT, NOT GOOD FOR SURFACES.

There is a pernicious practice among sidewalk makers—that of sprinkling neat Portland cement on the surface of the top coating before the latter has had time to secure its final set. This should not be followed.

* * *

CELLAR FLOORS OF CONCRETE.

In laying cellar floors the methods differ somewhat from those employed in sidewalk construction. Owing to the fact that the concrete is not

exposed to the action of wind and weather, there is a great deal less expansion and contraction, and in floor work under shelter, expansion joints are dispensed with.

For ordinary cellar floors, a layer of concrete not less than 1½″ thick, over a 4″ bed of cinders, is generally sufficient. The concrete should be mixed in the proportion of 1:3, with bank-run sand and gravel, and floated to a level.

Drainage is an important point to consider in cellar work, and where floors are to be laid on clay, sub-drainage, with tiles or otherwise, should be provided.

* * *

REPAIRING PLANK WALKS WITH CONCRETE.

It often becomes necessary under a city ordinance to build a new wooden walk when the old plank are perfectly good, on account of the stringers being too rotten to hold a nail. This expense can be avoided by putting in a concrete stringer without disturbing the plank. To do this, dig a small trench under each side of the walk, extending about 4″ under and about 4″ deep; drive spikes into the plank about 2″ from the edge of the walk, so as to extend down into the trench. Then fill the trench with concrete, tamping it up to the plank. If the plank are warped up at the end, weight them down until the nails are firmly set in the concrete stringer. This will insure you a foundation that will outwear your plank. Should there be any holes in the walk, cut out the rotten wood, fill in the cavity (if more than 3″ deep) with cinders well tamped; then fill with concrete to the surface. At a very small cost, an old walk may in this way be kept in repair for years.

* * *

REINFORCED SIDEWALKS OF CONCRETE.

If necessity requires that a sidewalk shall be built in such a location that the supporting soil is likely to be washed from beneath it, reinforcement is an excellent precaution. We have in mind such walks as are sometimes built on sandy soil, in locations liable to attack from unusually high water. If the sidewalk builder will lay a mesh of expanded metal, the width of the walk, and about two inches from the lower level of the bottom coat, he will have a construction that will at least support its own weight until such time as the underpinning can be replaced and tamped to a solid bearing surface. A six-inch mesh should be ample for all ordinary purposes.

* * *

CURB CONSTRUCTION IN CONCRETE.

After excavating to a proper depth, set frames for curbing with spreader board between, not less than four feet apart. Brace frames thoroughly opposite these spreading boards, keeping the outside frame at all times in line. Concrete for curbing should be composed of one part Portland cement to five parts clean, sharp sand and gravel, thoroughly mixed dry and then wet to a proper consistency. After the concrete has been thoroughly mixed, tamp in place, using sheet iron division plates to cut the curbing in sections not less than four nor more than six feet in length. The top coat of curbing should be at least ½″ in thickness and should consist of one

part of Portland cement to two parts of clean, sharp, screened sand, and should be thoroughly smoothed off with a trowel on the edges and finished to its desired shape with an edger or curb tool.

For business streets, curbing should be from 18″ to 22″ deep and 5″ in thickness at the top and 7″ at the bottom. For residences curbing may be 14″ or 16″ in depth, but of no less thickness than for street curbing.

There has been a great deal of discussion as to whether it is best to put the curbing on a business street outside of the walk or let the walk rest on the curbing. Experience has shown the latter method to be preferable; that is, let the walk rest on the curbing. This allows the walk to slide back and forth on the curb as it expands and contracts without disturbing the curb, while if it is placed outside the walk the expansion of the walk may displace the curb.

* * *

STREET CROSSING WORK IN CONCRETE.

The foundation for concrete street crossings should be the same as for sidewalks. The base should consist of a layer 4½ inches deep, composed of one part of Portland cement and four parts of clean sand and gravel, thoroughly mixed dry, properly wetted, and tamped to uniform grade. The surface should consist of a layer 1½ inches thick, composed of one part Portland cement and 1½ parts of good, clean, sharp screened sand, thoroughly mixed when dry and wetted to the consistency of thick mortar. This top surface should be thoroughly troweled into the base and finished to conform with a grade established by the city engineer.

* * *

LAYING A CONCRETE FLOOR OVER A WOOD FLOOR.

Many times it is desired to replace an old wood floor with one of concrete. This can be done by laying the new floor over the old. In preparing for this, examine all the joists well, nail down all loose boards, and during the construction and curing of the work, shore up all weak spots that may manifest themselves. Lay on the floor expanded metal or heavy wire cloth of not over six-inch mesh, tying down the ends with light wire staples. The strips should overlap one another about three inches. Wet the floor thoroughly.

Upon this, lay a course of concrete about 1½″ thick, except on driveways, where it should be 2½″ thick. Lay the floor in 4′ strips, returning after each operation and finishing that strip with a wooden float after leveling with a straight-edge. Repeat this operation the entire length of the floor. Be careful not to fracture the floor after the process of crystallization has started. This accident is likely to be caused by springing some of the boards adjacent to the newly-laid concrete.

The mixture should be 1 part Portland cement to 3 parts bank-run sand and gravel, to be laid in one continuous layer. Gutters may be formed where necessary. This process will be found valuable in repairing old barn floors and has been used with great success in any number of instances.

FROST LINE, DEFINITION OF.

The depth to which frost penetrates the ground, on the average, is called the frost line. Concrete and other footings should always be laid well below this point. The depth varies widely in different localities.

* * *

CENTERS AND ON CENTERS, USE OF THE TERM.

Joists are said to be laid with 18″ centers or 18″ on centers when the distance between the center of one and the one next to it is 18″. The same term is applied to beams and to reinforcing material, etc.

* * *

TENSILE STRENGTH, REQUIREMENTS FOR BRIQUETTES.

Specifications of the American Society of Civil Engineers require that the minimum tensile strength of briquettes, one square inch in cross-section, shall be as follows:

Age. Neat Cement.	Strength. Pounds.
24 hours in moist air	150-200
7 days (1 in moist air, 6 in water)	450-550
28 days (1 in moist air, 27 in water)	550-650
1 part cement, 3 parts sand.	
7 days (1 in moist air, 6 in water)	150-200
28 days (1 in moist air, 27 in water)	200-300

* * *

GREASE FOR FORMS OF WOOD FOR CONCRETE.

Crude petroleum, soft soap and linseed oil are used to coat wooden forms in order that concrete may not stick to them. They should be applied lightly, using only enough to fill the grain of the wood in the forms.

* * *

ROUGHENING CONCRETE SURFACES.

Besides using the bush-hammer and the bush-axe, it is possible to roughen concrete surfaces, especially for floors, by using a grooved or toothed roller, such as is used in sidewalk work. Another method is to apply a stiff brush to the surface of the concrete before it hardens. An ordinary scrubbing brush will answer the purpose, tapping the surface lightly, with the brush held parallel to the surface. Light, quick strokes should be used.

* * *

PARTITION WALLS, THICKNESS OF.

Except in extraordinary circumstances, partition walls of block need never be more than 8″ thick. Where they are reinforced, 4″ to 6″ is plenty thick enough.

* * *

ASPHALT FOR EXPANSION JOINT FILLER.

Asphalt makes a very satisfactory filler for expansion joints in concrete floors and walls. It may be applied hot, as in road-making, or dissolved in naptha or benzine.

BALL MILL, NATURE OF.

A ball mill for grinding cement ordinarily consists of a cylinder partially filled by hardened balls of steel or very hard stone. The balls, as the cylinder moves, grind the cement to powder. This type of mill is usually made use of for the first reduction of cement, which later passes to a tube mill.

* * *

CURING CONCRETE, IMPORTANCE OF.

Too much emphasis cannot be laid on the importance and necessity of curing concrete, in any form. Fundamentally, the process of curing has for its object maintaining concrete in such a condition that the crystallization of the cement may be perfected and that the hardening process may begin. Crystallization begins and proceeds only in the presence of sufficient water. It is therefore obvious that water must be constantly supplied to concrete until the hardening process is well under way.

Numerous systems of curing, all with the same object in mind, are in use. Perhaps the most common is the sprinkling process. Under this system, concrete is kept moist by spraying water on it from a hose. Care must be taken to make use of a fine spray and the water should be applied gently, but in abundant quantity. The sprinkling should be continued as often as the concrete gives the first sign of dryness, for at least two or three days. After this, it will not need attention quite so often. It is impossible to use too much water in curing, but care must be taken not to dash water against concrete while it is still "green."

Covering concrete surfaces with damp-retaining materials, like burlaps, hay, straw, sand, and so on, is often practiced.

Complete immersion in water, after the concrete has hardened sufficiently, is also used by many practical men.

(See also Steam-Curing.)

* * *

LYE, EFFECT OF, ON CONCRETE.

Lye is extremely detrimental to concrete, and where the element is present some means of protecting concrete from its action must be arranged.

* * *

CLAMPS FOR WALL MOLDS.

There are on the market a number of devices for holding plank forms rigidly in place while concrete is being poured into them. These consist of holders for securing the planks edge to edge and ties of various design to pass through the body of the completed concrete mass.

* * *

BURIAL VAULTS OF CONCRETE.

A branch of the concrete industry that is growing in importance is that of the manufacture of burial vaults. Forms of various type are sold, designed for casting impervious, hermetically sealed receptacles in which a casket may be placed. Several designs are available, each one possessing some special feature of importance.

RAILROAD TIES OF CONCRETE.

Owing to the increase in the price and the growing scarcity of lumber, a number of patents have been issued for the manufacture of railroad ties of concrete. These are of various types, the chief differences being in the methods of attaching the rails to the ties. The chief difficulty with the average railroad tie in concrete is its lack of resiliency. Attempts to overcome this have resulted in several ingenious devices, but no standard form has as yet been evolved.

* * *

NAME PLATE IN CONCRETE.

An excellent advertisement for the concrete man is to see that each piece of concrete manufactured by him bears his name. There are a number of methods for imprinting names and addresses in sidewalks, block, brick and so on. These consist of plates which are attached to the machine, or a stamp bearing the proper letters in negative is pressed into the surface of the concrete before it hardens, making a positive impression.

* * *

FACING A CONCRETE SURFACE.

The most satisfactory results in doing facing work are ordinarily secured by laying the facing at the same time as the body of the concrete mass. The certainty of a bond is in this manner assured. When, for any reason, it is desired to add a facing after the main body of the work is completed, the surface of the old concrete should be thoroughly cleaned with a solution of muriatic acid and water (about 1 part of acid to 10 of water), permitted to stay on the surface until the cement is etched away so as to expose sufficient of the aggregates to afford a positive bond for any new layer of concrete added. The surface should then be flushed off with clean water and kept wet while the new layer of concrete is being deposited. For general purposes a mortar made of 1 part of cement and 2 of sand, made quite wet, will give the best results.

* * *

WHITE PORTLAND CEMENT.

White Portland cement is made in the United States by the Sandusky Portland Cement Co., Sandusky, O., and The Bartlett Co., Jackson, Mich.

* * *

CHIMNEYS IN REINFORCED CONCRETE.

In all chimney construction in reinforced concrete, the reinforcement of the sides (vertical) must be firmly anchored into the foundation, in order that the foundation and the chimney proper may be monolithic. It is quite customary to build the lower portion of a reinforced concrete chimney in two complete shells, the outer for resisting wind pressure and the inner to allow for the expansion and contraction caused by varying temperatures.

* * *

LAMPBLACK (SEE EXCELSIOR CARBON BLACK).

The successful use of lampblack in concrete mixtures is difficult owing to the fact that it contains a percentage of mineral oil, which naturally

retards its thorough mixing with any mass of which water is a part. The lampblack should be added to the dry cement and mixed thoroughly until the mass is of uniform color. This should then be mixed with the dampened sand and aggregates before the water for the concrete mixture is added.

Lampblack is also used to streak the faces of concrete block and other products, giving the effect of marble. Lampblack may be secured from any dealer in paints and oils. One grade of the material will serve as well as another for use in concrete work.

* * *

CUBIC FOOT OF CONCRETE, MATERIAL FOR.

When concrete is correctly considered as a volume of aggregate bound together by mortar of adequate strength, then the essential points in proportioning concrete are: First, percentage of voids in aggregate to be filled with mortar; second, strength of the mortar. The following simple theoretical table shows the proportionment of cement to sand with a 1:3 mix per cubic yard of concrete for different percentage of voids.

Owing to the fact that in practical manipulation the pieces of aggregate should be individually separated by a thin coating of mortar, it is necessary to use a slight excess of mortar over that calculated in the determination of voids.

Per cent voids in Aggregate.	Cu. ft. in Aggregate.	Cu. ft. Mortar.	Cu. ft. Sand.	Cu. ft. Cement.	Stated in Proportions.
30	27	8.10	6.08	2.02	1:3:13
35	27	9.45	7.09	2.36	1:3:11
40	27	10.80	8.10	2.70	1:3:10
45	27	12.15	9.12	3.03	1:3: 9
50	27	13.50	10.13	3.37	1:3: 8
55	27	14.85	11.15	3.70	1:3: 7

* * *

CURB AND GUTTER OF CONCRETE.

Several devices for molding a concrete curb and gutter at one operation have been devised.

* * *

LOSS ON IGNITION, DEFINITION OF.

A sample of Portland cement or other material to be tested, is to be carefully weighed, after being thoroughly dried. It is then placed in a crucible and heated for 15 minutes, preferably with a flame directed at an incline. The loss of weight after heating is the so-called loss on ignition.

IRON, DETERMINATION OF.

The presence of iron in a suspected sample of cement, concrete or water is a matter for laboratory analysis and manipulation.

* * *

KILNS, TYPE USED FOR CEMENT BURNING.

Cement, under modern conditions, is burned in rotary kilns, supported on bearings and lined with fire brick. They are slightly inclined from the true horizontal. Heat is supplied by setting fire to finely powdered coal, a stream of which is blown by air across a flame. The raw material is heated to the point of incipient fusion, that is, until it just begins to fuse together into clinker. The clinker is removed, cooled, ground and aerated, when it becomes the Portland cement of commerce.

* * *

BOOKS ON CONCRETE.

If any of the readers of this book are interested in special lines of concrete work and want a book dealing exclusively with any one subject, it would be well to write to the publishers of "How to Use Concrete" and ask for their special catalog listing and describing *all* of the books published on concrete and kindred subjects.

* * *

CONCRETE BRICK, MATERIAL REQUIRED FOR.

Concrete brick are erroneously called *cement* brick. What is really meant is a brick made of cement, sand and water, and perhaps some fine gravel, which gives us a *concrete* mixture.

For brick of the ordinary class, use 600 lbs. of Portland cement and 40 cu. ft. of sand and fine gravel; for fine face-brick, use 800 lbs. of Portland cement and 40 cu. ft. of torpedo sand; for a concrete brick equal in every respect to the pressed brick of commerce, use 1,000 lbs. of Portland cement and 40 cu. ft. of torpedo sand.

The following figures are of interest:

1,000 1:3 brick take 3.8 bbls. of cement and 1.7 cu. yds. of sand.
1,000 1:4 brick take 3.05 bbls. of cement and 1.8 cu. yds. of sand.
1,000 1:5 brick take 2.55 bbls. of cement and 1.9 cu. yds. of sand.
1,000 1:6 brick take 2.18 bbls. of cement and 1:9 cu. yds. of sand.
1,000 1:7 brick take 1.9 bbls. of cement and 2 cu. yds. of sand.

* * *

"PORTLAND" CEMENT, ORIGIN OF THE NAME.

Portland cement takes its name from the fact that the product, in England, back in 1824, resembled the product of the Portland quarries, well known as producers of stone. It was then a yellowish gray in color.

* * *

DELETERIOUS SUBSTANCES, DETERMINATION OF.

Investigations looking to the determination of deleterious substances in suspected Portland cement or concrete are best carried on in a laboratory especially equipped for this class of work.

CARLOAD OF PORTLAND CEMENT.

One hundred (100) barrels of Portland cement usually constitute a carload. The minimum carload is 75 barrels, or the same quantity by weight in bags of cloth or paper.

* * *

CLOTH BAGS, VALUE OF.

Cement companies pay a price ranging from $7\frac{1}{2}$ cents to 10 cents each for cloth bags that have contained their brand of cement, when they are returned to the mill. In order to be credited, bags must of course be in good condition; the count is subject to verification at the mill.

* * *

MIXERS, ADVANTAGES OF, FOR CONCRETE.

Machine mixing, without any question whatever, is best for concrete. The machine produces a quicker mix, does the work more thoroughly and with much greater uniformity. A mixer works as well at the end of the day as it does in the first half hour. With modern equipment, the matter of securing an absolutely accurate, homogeneous mass of concrete is simply one of seeing that the amounts of cement, sand and gravel or stone requisite for the proportions desired, together with water in quantity necessary for making the mass of the required degree of moisture, are supplied. This needs the right kind of a man in charge of the mixer, but the right kind of a man in charge is necessary in every department of cement and concrete manufacture.

Under modern conditions, mixers of practically any desired size, operated by hand or by power, and for batch or continuous work, are available. Hand mixing, except on jobs so small that it would be a waste of time to measure the requisite quantities into a mechanical mixer, will very shortly be a thing of the past.

The chief thing to see to in mixing of any kind is that the operation is thorough. When cement, sand, gravel, stone and water are properly mixed, the mass will be homogeneous, that is, it will be of the same consistency throughout. Any coloring matter introduced into the mass will be uniformly distributed throughout.

All that has been said on the subject of selection of materials applies of course to any consideration of mixing. Given proper materials and the right kind of mixing, good concrete will infallibly result.

* * *

MONOLITHIC WORK IN CONCRETE.

Any solid mass of concrete that is a unit is monolithic concrete, properly speaking, for the term means "consisting of a single stone." Monolithic concrete is ordinarily applied to heavy mass concrete in one block, such as is used in foundations and so on. But the abjective is also applied to reinforced concrete construction, when the reinforcing binds the elements together. Thus, a wall and a foundation are said to be monolithic when they are so constructed as to form an inseparable unit or mass.

Monolithic work in concrete is usually constructed without reinforcement, the construction depending for stability upon its mass and weight.

Comparatively lean mixtures are used in work of this class—1:3:5 or even less. Proportions will always be governed by the work that the construction is called upon to do.

* * *

AREAS COVERED BY PLASTER.

A mortar made of 1 barrel of cement and 1 of sand, 1″ thick, will cover 67 square feet; ¾″, 90 square feet; ½″, 134 square feet. Mortar made 1:2, 1″ thick, will cover 104 square feet; ¾″, 139 square feet; ½″, 208 square feet. Mortar made 1:3, 1″ thick, will cover 140 square feet; ¾″, 187 square feet; ½″, 280 square feet.

* * *

MORTAR REQUIRED IN MASONRY.

In laying a cubic yard of brickwork, with ⅛″ joints, there are required .15 cubic yards of mortar; with ¼″ joints, .25 cubic yards; with ½″ joints, .40 cubic yards. In ashlar work, with 20″ courses, .06 cubic yards; squared stone masonry, .20 cubic yards; rubble masonry, .25 cubic yards; concrete, using broken stone, .55 cubic yards.

* * *

RETEMPERING CEMENT MORTAR.

The best advice in regard to tempering cement mortar is the advice that Mr. Punch gave to the young man about to be married: "DON'T "

* * *

SPECIFICATIONS FOR PORTLAND CEMENT.

All of the standard brands of Portland cement, sold in the United States, conform to the specifications of the American Society for Testing Materials. These specifications insure a uniform, staple product.

* * *

WATERPROOFING CONCRETE.

There are a number of excellent products now on the market for insuring the absolute waterproofness of concrete with which they are combined. None of them will accomplish the impossible, and while they will often make quite porous concrete water-repelling, they will not wholly take the place of well graded aggregates, honest cement in quality and quantity, and plenty of clean water. For all outside works, like walls, roofs and so on; for foundations, floors and other work below grade; and for tanks, cisterns and similar construction, the addition of some waterproofing is highly advisable.

* * *

OTTAWA STANDARD SAND.

"Ottawa standard sand, 20-30," is a white silica sand mined at Ottawa, Ill., and used for testing purposes in laboratories all over the country. Committees of the American Society of Civil Engineers and the American Society for Testing Materials have made the sand so prepared the standard for tests to ascertain the strength of Portland cement, lime and gypsum products.

The sand is carefully screened and every bag is tested in the laboratory

before it is sealed for shipment Ottawa standard 20-30 sand passes the 20-mesh screen and 99% is retained on the 30-mesh screen. It is furnished in 100-lb. bags by the Ottawa Silica Co.

* * *

PILES OF CONCRETE.

Under various forms patents on concrete piles have been granted. They are molded over a steel core or in a steel shell and driven like wooden piles.

* * *

REINFORCED CONCRETE PIPE.

Sewer pipe and other forms of piping that are called upon to resist fluids under pressure are constructed of reinforced concrete. Metal fabric, expanded metal or rods, the latter placed according to the resistance to be developed, are all used in different forms of reinforcing.

* * *

WHEN NOT TO MAKE CONCRETE.

Concrete should not be made where rain will fall into the mass and ought not to be manufactured when the temperature is lower than 35 degrees Fahrenheit in the shade.

* * *

TUNNEL CONSTRUCTION IN CONCRETE.

Concrete has proved its value many times in the construction of tunnels. The railroads have been large users of the material and a recent conspicuous example of successful use is in the Detroit River crossing of the Michigan Central, between Detroit, Mich., and Windsor, Ont. The tube consists of a shell of steel, embedded in a monolithic square of concrete from 3′ to 4′ 6″ thick. The inside is lined with concrete and all ties are laid in the same material. Approaches, stairways, platforms and so on are constructed of concrete.

* * *

SILO BLOCK IN CONCRETE.

By means of a suitable attachment, many of the concrete block machines now on the market can turn out silo block for a given radius, so that when placed edge to edge the block will form a circle the desired size of the silo.

* * *

SHINGLES OF CONCRETE.

Several machines are on the market for the manufacture of concrete shingles for roofing purposes. The machines provide for various forms of shingle and for differing means of attaching the finished product to the roof foundation.

* * *

THICKNESS OF LAYERS OF CONCRETE.

As a general proposition, it is wise not to deposit concrete in layers more than 6″ or 8″ in thickness, when further concrete work is to be done

immediately. As a general rule, too, it is best to complete one entire layer, as in a foundation, before the next layer is added to the height.

* * *

SEWERS OF CONCRETE.

For sewer construction, concrete is the ideal material. Its plasticity makes it valuable for use in forming intricate bends and curves and it may easily be reinforced so as to resist pressure from within and without.

* * *

CITIES USING REINFORCED CONCRETE SEWERS.

Cities using reinforced concrete in sewer construction in this country include the following: Wilmington, Del.; Denver, Col.; Brooklyn, N. Y.; Milwaukee, Wis.; Pittsburg, Pa.; Flint, Mich.; Jackson, Mich.; Wyandotte, Mich.; Boston, Mass.; Salt Lake City, Utah; New York, N. Y.; Vancouver, B. C.; Coldwater, Mich.; Newark, N. J.; Beverly, Mass.; Cleveland, O.; Indianapolis, Ind.; Truro, N. S.; Corning, N. Y.

* * *

WATERTIGHT MORTAR FOR CONCRETE WORK.

In using lime putty for watertight mortar, it should be mixed in the following proportions:

1 part cement, ½ part lime putty, 1 part sand; 1 part cement, 1 part lime putty, 3 parts sand; 1 part cement, 1½ parts lime putty, 5 parts sand; 1 part cement, 2 parts lime putty, 6 parts sand.

The sand and cement should be thoroughly mixed, dry, and the lime putty, dissolved in water, should be screened into the mass; if necessary, more water should be added until the mortar is of the desired consistency.

* * *

SILICA CEMENT.

At some factories, cement is made by a special process, which includes the mixture of Portland cement and dry sand, thorough mixing being followed by fine grinding. The resulting product is known as silica cement.

* * *

SLAG FOR CONCRETE.

The molten slag from blast furnaces, cooled with water and ground, has been used as aggregate in concrete and shows high tensile strength.

* * *

SUBWAY CONSTRUCTION IN CONCRETE.

Both New York and Boston have made extensive use of concrete in subway construction and the material has proved its value in solving many problems incident to subway construction.

* * *

JOIST HANGERS.

In concrete block construction, it is often convenient to use joist hangers. These are stirrups of iron, so arranged that the edge of the joist rests in a frame, the joist being supported by the bearing of the top of the frame between two courses of block.

FIRST PORTLAND CEMENT IN AMERICA.

The first Portland cement manufactured in America was made by Saylor in the Lehigh district, Pennsylvania, in 1875.

* * *

ANTIQUITY OF CONCRETE.

The use of concrete is very old. Egyptian excavations show that the ancients were familiar with the manufacture and use of cement in concrete. The dome of the Pantheon, at Rome, is constructed of cinder concrete, only 4″ thick, still in excellent preservation. The Romans used concrete extensively in the construction of roads, walls, fortifications, sewers and so on.

* * *

ELASTIC LIMIT.

Steel is said to have reached its elastic limit when a load is applied to it of such weight that when the load is removed the steel member does not return to its normal form. The average elastic limit of steel is from 30,000 to 60,000 pounds to the square inch, depending upon the hardness of the steel.

* * *

FORMS FOR CONCRETE WORK.

In undertaking construction in reinforced or monolithic concrete, the question of forms is of great importance. Forms are generally made of wood, though the special type of metal form, in steel, is coming into continually greater prominence.

Forms should be made of lumber, dressed at least on the side that is next to the concrete, and set up in such a way that they are braced against bulging when the heavy, wet concrete is placed in them. It is of course essential to see that forms are set up level and plumb and that they are then held rigidly in place until the concrete has hardened to such a degree that the forms may be removed with perfect safety.

All forms for column work should be so constructed that a portion of one side at the bottom is removable and this should be lifted the very last thing before concrete is poured into the form, in order to make sure that no chips, sawdust or other dirt has accumulated in the bottom of the form, where it will do the most harm. Forms for beam, girder and panel work should be carefully supported on shores figured to carry the live and the dead weight with safety. No formal rule can be given as to the time at which forms may be removed. The essential thing is to make certain that the removal can be accomplished without menacing the safety of the structure.

* * *

DANISH PEBBLES.

Danish pebbles are flint stones imported from Scandinavia for use in tube mills in Portland cement plants. These hard, round stones are placed in the long steel cylinders with the partially ground rock or cement clinker. The cylinders move at the rate of about 26 revolutions per minute and the constant rolling and grinding of the pebbles reduces the rock or clinker to an almost impalpable powder.

REPAIRING TREES WITH CONCRETE.

When trees are decayed, to such an extent as to present a cavity, it is practicable to restore them by using concrete to fill the hole. Before beginning this work, every particle of decayed wood should be carefully removed from the cavity and nails driven partially into the sound wood, in order to provide for a close bond between the wood and the concrete filling. In case the cavity is so large as to endanger the stability of the trunk, some method of reinforcing should be installed, in the form of rods which will assist in holding the trunk rigid.

Concrete should be poured into the hole in a wet condition, in order that every small irregularity may be filled and that the concrete, when hardened, will fill the cavity so closely as to prevent the entrance of moisture. Under ordinary circumstances, when concrete is used in repairing trees, the bark grows over the filled spot, unless the latter is very large in extent, and the scar is covered. It is of course perfectly possible to paint the concrete in such a way as to resemble the natural color of the tree trunk.

* * *

DAMS OF REINFORCED CONCRETE.

In general, dams are best built hollow, of a 1:2:4 concrete, the walls and subdivisions carefully reinforced to provide sufficient resistance to water pressure and also to the weight of any pumping engines or other machinery placed on the upper portion of the dam. Buttress and slab construction will assist in solving the problem of sufficient resistance.

* * *

CONCRETE RESEMBLING NATURAL STONE.

By proper selection of aggregates, concrete may be made that is a perfect reproduction of natural stone. For example, if particles of black and of white stone are combined, in the same proportions as they occur in natural granite, and then thoroughly incorporated in a mixture with Portland cement and water, the resulting stone will be granite, artificially manufactured. Nature is sensible enough not to cover her stones with a film of neat cement and man ought to be sensible enough to follow her good example. Bear in mind the fact that the function of Portland cement is to bind together the particles of aggregate—nothing further. The neat cement that forms in a film on the surface of concrete is an indication that there has been waste. Make it a point to select your aggregates with such care and of such a quality that they will bear inspection. Take off the film of neat cement and let people see what your concrete really is. Portland cement is the best structural binder that has ever been known. It completes this function absolutely and should not be called upon to do more.

* * *

PATENTS, GOVERNMENT OFFICIAL IN CHARGE OF.

In matters pertaining to patents and patentability, application should be made to Commissioner of Patents, United States Patent Office, Washington, D. C.

PILASTER CONSTRUCTION OF CONCRETE BLOCK.

Concrete block adapt themselves with great ease to use in building pilasters in industrial building construction. After the footing is laid in the ordinary manner for foundations, steel rods of suitable length should be placed in the footing, anchoring them by bending them over a foot or so in the direction of the length of the wall, at the site of the proposed pilasters. Over these rods are slipped concrete block of the desired size, the rods passing through the core spaces in the block. When the top course of block has been laid, the space surrounding the rods in the cores should be filled with grout. This form of construction makes the pilasters monolithic with the foundation and is strong and satisfactory. Curtain walls may be built of 8″ block, since they will not be called upon to bear any particular weight, this being taken care of by the pilasters of reinforced block.

* * *

TELEGRAPH, TELEPHONE, ELECTRIC LIGHT AND POWER POLES OF CONCRETE.

Telegraph, telephone, electric light and power poles of concrete have been used in Europe and in this country with a reasonable degree of success. They are made in a variety of ways. Several European manufacturers, and at least one American firm, reinforce the poles with wire fabric and roll them as a cigar is rolled.

Other pole manufacturers mold the poles in forms as concrete piles are made.

The Home Telephone Co., Richmond, Ind., has used reinforced concrete poles on its lines for several years. These poles are cast in situ. Metal forms are set up over the post hole, steel rod reinforcement is placed and a sloppy wet mixture of concrete is poured in at the top. Special equipment, which is comparatively inexpensive, is required for erecting the forms and elevating the concrete.

The advantages of concrete poles over those of wood, iron or steel are doubtless familiar to all. Wood poles have short lives and metal poles rust off at the ground line. Concrete poles withstand all the strain placed upon them and grow stronger with age. The Pennsylvania Railroad has experimented with telegraph poles of concrete on the lines west of Pittsburg. A number of power companies in Illinois are using concrete poles for stringing their cables and power transmission wires.

* * *

REINFORCING.

Reinforced concrete, a combination of concrete and steel, has been used with increasing field ever since the time of the Frenchman, Lambot, who built a small boat of concrete, spreading the material over a skeleton of steel, and exhibited it at the Paris exposition of 1855. In 1867, Monier, another Frenchman, took out some patents on a system of constructing tubs and tanks of concrete over a framework of steel. What is generally regarded as the first reinforced concrete work in America was a building erected in New York City by W. E. Ward about 1875. Since that time the use of reinforced concrete in America has been steadily on the increase.

Early users of concrete in building construction recognized the fact that while concrete readily resists heavy compressive stresses, it has comparatively little resistance to tensile, or pulling strain. Steel, on the other hand, while high in resistance to tension, is comparatively low in resistance to compression. Steel fails under comparatively low temperatures, while concrete resists comparatively high ones. Steel is expensive, concrete is cheap. A judicious combination of the two materials makes for the best qualities of both, without so high a cost as would be necessary if an individual member were to be constructed of the one material only, designed to meet excessive stresses of any nature.

In the development of the use of reinforced concrete, numerous types of steel reinforcement are used. Most of these consist of some form of bar, pressed or rolled into such a shape as to provide for an increased mechanical bond between the steel and the concrete, owing to the presence of protuberances, corrugations or angles, into or against which the concrete is made to flow before it hardens. Provision for striking up some portion of the reinforcing member, in such a way as to provide against shearing stress, is also an important part of the manufacture of reinforcing material.

Modern use of reinforcing material includes the design of reinforcement that can be placed as a unit, the individual parts of which can be closely and rigidly connected, in such a manner as to provide for unit stability while the concrete is being placed and while it is undergoing the hardening process.

The practical use of reinforced concrete involves the use of certain mathematical principles and formulae, much too extensive to undertake in a book of this size and scope. There are a number of handy treatises on the subject of reinforced concrete, available for the student of the subject, but no safe "rule of thumb" method has as yet been devised for the use of combinations of concrete and steel.

* * *

REINFORCING FABRICS.

The increasing importance and use of reinforced concrete has developed a number of reinforcing fabrics, apart from the industry of producing rods and lateral and upright construction member reinforcing. Expanded metal, wire cloth and so on, in which a sheet of metal is so fabricated as to make a series of meshes or openings, have made an important place for themselves in all modern building construction. Various patents have been issued for the fabrics. In some the metal is punched out, in others the intersections of meshes are welded, in some tied, and so on. For floor and roof construction and for the satisfactory modeling of slabs for all purposes, these reinforcing fabrics have an important part to play.

* * *

FENCE POST MACHINES.

With the rapid disappearance of lumber of all grades, the demand for a better fence post than is now ordinarily obtainable in wood is constantly growing. This has been met by the invention of a number of methods by which concrete is molded into proper form, properly reinforced, for supporting fencing of various types. Hand and power machines are both

available and at prices that enable a small community to make use of an outfit with ease and economy.

* * *

CUTS OF CONCRETE WORK.

It very often happens that a concrete man would like to get hold of some good illustrations of concrete work done in different parts of the country. These could often be used to advantage in showing prospective customers what can be done with the material in which we are all interested. The Concrete Publishing Co., at Detroit, Mich., has a number of these cuts on hand, and on request a sheet of proofs, with prices, will be sent to any address without charge.

* * *

FORMS FOR MONOLITHIC WORK.

Mention has been made elsewhere of methods of holding plank forms in place while concrete is poured into them. There are also on the market some ingenious devices in metal of various types, in which the form and the core come ready for use on the wall. Collapsible cores that can be withdrawn when the concrete has set, are a feature of one type of this variety of form.

* * *

CIRCLE BLOCK, MOLDS FOR.

For the construction of any building that has walls in the shape of a circle or that occupy the arc of a circle, there are machines that turn out "circle block" in concrete. These are useful in the construction of silos, round houses, towers, round tanks, and so on. An ingenious arrangement provides for the manufacture of block that will fit on circles of different diameter, made on the same machine.

* * *

SELECTED AGGREGATE IN CONCRETE.

The alert concrete man will early make use of the fact that it is the aggregates that count in the appearance of the finished product. Too much care cannot be exercised in having clean, well colored, well selected sand, gravel and stone. For this reason, there are a number of firms that make a business of supplying unusually desirable sand and gravel for concrete work.

* * *

CALCIUM CHLORIDE IN CONCRETE WORK.

Extensive experiments in concrete work done under severe weather conditions, in which the temperature has been low, show that the use of calcium chloride furnishes a safeguard against the dangers ordinarily attendant upon concrete work in cold weather. It has been found that the addition of two (2) per cent of calcium chloride to the water with which concrete is mixed has the effect of making the resulting cement mortar as strong as that made in a warm room, with a temperature of 60 to 70 degrees Fahr. About 10 to 15 per cent of water is ordinarily used in making concrete. Calcium chloride is a very deliquescent salt, that is, it

dissolves very readily in water, for which it has a very strong affinity. The effect of the addition of the calcium chloride to the water is to make a 15 to 20 per cent solution of the salt, which has a freezing point of from 14 degrees to 1 degree below zero, Fahr.

* * *

CHIMNEY BLOCK IN CONCRETE.

The all-concrete house needs a concrete chimney, of course, and to aid the builder there have been devised machines for the special manufacture of chimney block. These deliver the block on the pallet with flue holes of various size, ready to lay in the chimney as soon as they are cured.

* * *

REINFORCED CONCRETE CURBS.

Many cities build curbs of concrete, reinforced with steel members which come to the surface at the upper outside corner of the curb, forming a hard wearing surface that resists the impact of wheels and heavy bodies. The curb is built in place in wood forms, the metal reinforcing bar being placed so that the concrete can be finished even with it, leaving a monolithic curb with a steel wearing corner.

* * *

LEVELS FOR CONTRACTORS.

Special levels are manufactured for contractors for running foundation lines, grade lines and street levels. These levels are made in a variety of models and have a wide range of price.

* * *

BELTING.

The manufacture of Portland cement calls for a large amount and variety of belts and the belting industry has benefited greatly by the increasing popularity of concrete construction. In cement mills, the heavy grinding machinery and the long kilns, require high power and the belts for power transmission must be made to stand hard wear. The belts subjected to the hardest usage however are conveyor belts, which carry material in various forms and of various degrees of heat, from one department to another. The life of a conveyor belt is sometimes as short as 30 days, although the better grades last from six months to a year.

* * *

SIDEWALK LIGHTS.

One of the chief uses of concrete is the construction of lighted platforms over underground vaults. There are a number of systems on the market for the construction of sidewalks, platforms and roofs with light prisms for letting daylight into the place beneath. Most of these systems comprise special reinforcing members, forms and glass lights. The forms are set up, the reinforcing placed and the glasses arranged before the wet concrete is poured.

* * *

CEMENT WORKERS' TOOLS.

While most manufacturers of plasterers' and masons' tools handle a

line of concrete tools, there are firms that make a specialty of manufacturing tools for the exclusive use of concrete workers. Such lines include jointers, groovers, edgers, circle edgers, square edgers, corner tools, corrugators, curb tools, gutter tools, tuck pointers, aluminum floats, roller jointers, roller edgers, aluminum hawks, indentation rollers, line rollers, driveway rollers, hand rammers, pein end tampers, name-plates, etc.

* * *

CONCRETE BARROWS AND CARTS.

The handling of concrete, especially in very wet form, in common wood or steel wheelbarrows is not always successful, and barrow manufacturers have placed upon the market a number of patented forms of concrete barrows and carts, made of steel. Most of these have special devices to assist in dumping the wet mass quickly and cleanly.

* * *

WIRE CLOTH.

Wire cloth is a term applied to a form of reinforcing fabric made of wires tied, crimped or welded at their intersections to form long strips of varying dimensions. Such reinforcement is used for floors, roofs and interior partitions, much as expanded metal mesh is used.

* * *

SHOVELS.

Manufacturers of contractors' shovels have not been slow to recognize the importance of the concrete business and several of them have put out special shovels for handling concrete. There is a vast amount of detail in the manufacture of shovels that is not appreciated by the average man who uses one. Shovels for mixing concrete have a definite length of handle and a special shape of bowl, to enable the user to turn the mass quickly and with the minimum amount of labor. Shovels for placing concrete into forms are of different design, with a bowl that will carry the maximum amount of concrete and discharge it with the least possible disturbance in the mass. Special forms of shovels are used for handling sand, gravel and cement, so that the man who has been in the habit of calling a spade a spade, must in the future be more detailed.

* * *

HOUSE PLANS.

Plans for concrete houses—reinforced, monolithic, brick, block and stucco—are always of value to the prospective home builder and to the contractor who is in search of ideas and suggestions. The publishers of the monthly magazine "CONCRETE," Detroit, Mich., print two house plans, with descriptions and estimates of cost, each month in the reading pages of the journal, and have for sale a number of different books of plans for concrete, brick, wood and stone dwellings to range in price from $600 to $50,000.

* * *

EXPANSION BOLTS AND WALL PLUGS.

One of the most important points in erecting concrete buildings, especially factory and business blocks, is the provision of means for fastening

wood studding, iron work, gas and electric fixtures, etc., to the walls, floors and ceilings. There are manufactured a number of good models of expansion bolts which are easily introduced in the concrete after the building is up, and form effective holds for attaching wood and steel fixtures.

Wall plugs are metal devices laid in the mortar joints when the concrete walls are being laid up and, when the building is completed, form a secure fastening to receive nails by which furring, studding, etc., are fastened to the walls.

* * *

AUTOMATIC TAMPERS.

One objection to concrete block, brick and tile that have been tamped by the old fashioned "armstrong" power, has been the likelihood of the last block made in the day being less dense than the first block made in the morning. The man behind the tamper naturally gets tired and his stroke gradually loses force. This objection has been overcome by the introduction of the mechanical tamper. There are several different types of these. Some require a small compressed air outfit which drives a pneumatic tamping tool in the hand of the man at the machine. Other automatic tampers are purely mechanical, the apparatus being erected directly over the block, brick or tile machine. The tamping arms are adjustable so as to work on any shape or size of mold box and when not in operation are raised up above the machine to allow the product to be released and carried away.

* * *

TYPES OF CONCRETE BLOCK.

To attempt to describe and illustrate here all the different types of concrete block would be futile. Lack of space forbids it and the activity of the inventors of block machines would place the list out of date inside of a month.

The first patent on a concrete building block of which we can find a record was No. 53,004, issued to C. S. Hutchinson March 6, 1866. Thomas J. Lowry was granted patent No. 80,358 July 28, 1868, on a hollow concrete block. These block had hollow air spaces molded by cores in the machine. Harmon S. Palmer, one of the earliest concrete block machine makers, claims the first patent on a machine with removable cores and side plates, molding hollow block. From these early dates to the present time we have seen a constant procession of concrete block of various types. The size, shape and position of the air-space seem to have been the features that appealed most to the inventors and today there are on the market a large number of machines making building block with vertical air spaces, double-staggered air spaces, horizontal air spaces, round, square and diamond shaped. Each of these distinctive types doubtless has much to recommend it.

The wall of the building naturally takes its form in a great measure from the type of block used. Many builders prefer to build a wall with a continuous, unobstructed air space throughout. They build two walls of shallow solid block, tied together by wall ties. There are enthusiastic advocates of these hollow walls, of walls of hollow block and of solid concrete walls. The respective merits of these different forms of con-

struction can best be decided by the reader after investigating jobs where they have been properly used.

* * *

TYPES OF CONCRETE BRICK.

Concrete brick are generally made in standard sizes and most machines have attachments for molding brick with fancy faces, tooled corners, bevels, etc. There are machines that mold a sunken panel in the bottom of each brick to receive the mortar in laying. This feature is claimed to give a more stable wall. Concrete brick, properly made, laid in good Portland cement mortar, will give a wall strong enough for anyone—much stronger than the best clay brick wall of the same thickness.

* * *

CUBIC YARD OF CONCRETE, MATERIAL FOR.

In figuring on bids, the contractor often has occasion to use a table indicating the amounts of materials required for a certain amount of concrete. The following table will be found valuable in such a case, telling as it does, how much sand, cement, and stone are required for one cubic yard of concrete of various proportions.

CONCRETE WITH GRAVEL ¾" AND UNDER.

Proportions of Mixture.			Required for One Cubic Yard.		
Cement.	Sand.	Gravel.	Cement. Bbls.	Sand. C. Yds.	Gravel. C. Yds.
1	1	2.0	2.72	0.41	0.83
1	1	2.5	2.41	0.37	0.92
1	1	3.0	2.16	0.33	0.98
1	1.5	2.5	2.16	0.49	0.82
1	1.5	3.0	1.96	0.45	0.89
1	1.5	3.5	1.79	0.41	0.96
1	1.5	4.0	1.64	0.38	1.00
1	2.0	3.0	1.78	0.54	0.81
1	2.0	3.5	1.66	0.50	0.88
1	2.0	4.0	1.53	0.47	0.93
1	2.0	4.5	1.43	0.43	0.98
1	2.5	3.5	1.51	0.58	0.81
1	2.5	4.0	1.42	0.54	0.87
1	2.5	4.5	1.33	0.51	0.91
1	2.5	5.0	1.26	0.48	0.96
1	2.5	5.5	1.18	0.44	0.99

CONCRETE WITH 2½" STONE.

Proportions of Mixture.			Required for One Cubic Yard.		
Cement.	Sand.	Stone.	Cement. Bbls.	Sand. C. Yds.	Stone. C. Yds.
1	1	2.5	2.10	0.32	0.80
1	1	3.0	1.89	0.29	0.86
1	1	3.5	1.71	0.26	0.91
1	1	4.0	1.55	0.24	0.94
1	1.5	3.0	1.71	0.39	0.78
1	1.5	3.5	1.57	0.36	0.83
1	1.5	4.0	1.46	0.33	0.88
1	1.5	4.5	1.34	0.31	0.91
1	1.5	5.0	1.24	0.28	0.94
1	2.0	3.5	1.44	0.44	0.77
1	2.0	4.0	1.34	0.41	0.81
1	2.0	4.5	1.26	0.38	0.86
1	2.0	5.0	1.17	0.36	0.89
1	2.0	6.0	1.03	0.31	0.94
1	2.5	4.0	1.24	0.47	0.75
1	2.5	4.5	1.16	0.44	0.80
1	2.5	5.0	1.10	0.42	0.83
1	2.5	5.5	1.03	0.39	0.86
1	2.5	6.0	0.98	0.37	0.89
1	2.5	7.0	0.88	0.33	0.93

(*Continued from page 217*)

Concrete with Gravel ¾″ and Under.

Proportions of Mixture.			Required for One Cubic Yard.		
Cement.	Sand.	Gravel.	Cement. Bbls.	Sand. C. Yds.	Stone. C. Yds.
1	3.0	4.0	1.32	0.60	0.80
1	3.0	4.5	1.24	0.57	0.85
1	3.0	5.0	1.17	0.54	0.89
1	3.0	5.5	1.11	0.51	0.93
1	3.0	6.0	1.06	0.48	0.97
1	3.5	5.0	1.11	0.59	0.85
1	3.5	5.5	1.06	0.56	0.89
1	3.5	6.0	1.00	0.53	0.92
1	3.5	6.5	0.96	0.51	0.95
1	3.5	7.0	0.91	0.49	0.98
1	4.5	6.0	0.95	0.58	0.87
1	5.0	6.5	0.91	0.55	0.90
1	4.0	7.0	0.87	0.53	0.93
1	4.0	7.5	0.84	0.51	0.96
1	4.0	8.0	0.81	0.49	0.98
1	5.5	8.0	0.74	0.57	0.91
1	5.0	9.0	0.70	0.53	0.96
1	6.0	9.0	0.65	0.59	0.89
1	6.0	10.0	0.62	0.56	0.93
1	7.0	11.0	0.54	0.51	0.91
1	7.0	12.0	0.52	0.55	0.95

Concrete with B½″ Stone.

Proportions of Mixture.			Required for One Cubic Yard.		
Cement.	Sand.	Stone.	Cement. Bbls.	Sand. C. Yds.	Stone. C. Yds.
1	3.0	5.0	1.03	0.47	0.78
1	3.0	5.5	0.97	0.44	0.81
1	3.0	6.0	0.92	0.42	0.84
1	3.0	6.5	0.88	0.40	0.87
1	3.0	7.0	0.84	0.38	0.89
1	3.0	7.5	0.80	0.37	0.91
1	3.0	8.0	0.76	0.35	0.93
1	3.5	6.0	0.88	0.46	0.80
1	3.5	6.5	0.83	0.44	0.82
1	3.5	7.0	0.80	0.43	0.85
1	3.5	7.5	0.76	0.41	0.87
1	3.5	8.0	0.73	0.39	0.89
1	3.5	8.5	0.71	0.38	0.91
1	3.5	9.0	0.68	0.36	0.92
1	4.0	7.0	0.77	0.47	0.81
1	4.0	7.5	0.73	0.44	0.83
1	4.0	8.0	0.71	0.43	0.86
1	4.0	8.5	0.68	0.42	0.88
1	4.0	9.0	0.65	0.40	0.89
1	4.0	9.5	0.73	0.38	0.91
1	4.0	10.0	0.61	0.37	0.93
1	5.0	10.0	0.57	0.43	0.87
1	5.0	12.0	0.51	0.38	0.92
1	6.0	12.0	0.48	0.44	0.88
1	6.0	14.0	0.43	0.40	0.92
1	7.0	14.0	0.42	0.44	0.88
1	7.0	16.0	0.38	0.40	0.92

* * *

MANTELS.

We describe elsewhere in this book the methods by which a concrete mantel and fireplace may be built. Manufacturers of wood, terra cotta and tile mantels sell special designs particularly adapted for use in houses built of concrete. There are a number of firms who manufacture, for sale, concrete mantels of highly artistic design.

* * *

ASBESTOS CONCRETE SHINGLES.

Shingles of a variety of shapes and colors are made of asbestos fibre

and cement, formed and compacted by hydraulic pressure. These shingles are of course waterproof and have the added advantage of being fireproof.

* * *

DERRICKS AND HOISTS.

Concrete contractors will find that a small investment in a patent derrick or hoist will pay big dividends. Several derricks are made with special reference to the needs of contractors who have to handle monolithic concrete, block and separately molded reinforced concrete members on the job. Hoists and derricks for handling buckets and barrows of concrete mixture are labor-saving devices that should be found in the equipment of every up-to-date concrete man who has much concrete to handle.

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WALL TIES, LIFE OF.

Wall ties are everlasting, if dry. If they are alternately dry and wet, a fair average life would be twelve years.

* * *

LIMESTONE FOR CONCRETE.

Limestone, especially where it is used just as it comes from the crusher, is not first-class concrete material. There is too high a percentage of "flour," or fine stone particles, in it. As a general thing, limestone is apt to be subject to deterioration from the weather and is often too soft to make the best concrete. Where other stone is available it should be preferred.

* * *

VERANDAH FLOORS OF CONCRETE.

It is a simple matter to make porch or verandah floors of concrete. The wood stringers laid for a wooden floor will answer, if they are chamfered down so that they will not come up too high into the concrete mass. Horizontal strips are nailed on the stringers and, on these, short boards are fitted, making shallow troughs between each pair of stringers. In the troughs lay three inches of cinders, well tamped down, and on these lay concrete as if for a sidewalk. The bottom portion of the porch should be ventilated, to keep the stringers from rotting out. Expansion joints, as in sidewalk work, should be provided.

* * *

OIL TANKS OF CONCRETE.

Concrete is well suited for the construction of all kinds of tanks for storing oil. If it is feared that the oil may attack the concrete, it is a simple matter to make a lining of sheet metal, while the body of the tank, of concrete, is easily and cheaply made, and is everlasting.

* * *

BROWN SPOTS IN CONCRETE.

The presence of iron in the water or the material of which concrete is composed sometimes causes the appearance of small brown spots, like smallpox pits, on the surface of the concrete. Where there is any doubt as to whether or not there is iron present, the suspected material should be sent to a good laboratory for analysis and report.

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